Principles of Universal Physiology

Dr. Camilo Calleja

PRINCIPLES OF UNIVERSAL PHYSIOLOGY

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A REFORM IN THE THEORIES OF
PHYSICS, CHEMISTRY, BIOLOGY, AND COSMOLOGY

BY

CAMILO ÇALLEJA, M.D.

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PREFACE.

THIS little book is a compendium issued in advance of a complete work called "Universal Physiology," which intends to reform the whole theory of Natural Science—*i.e.*, Physics, Chemistry, Biology and Cosmology. This comprehensive theory, which completely rectifies the opinions held by the authors of such treatises, we call Physiological. We adopt the word Physiology in its etymological sense—discourse of Nature; and though it has been very commonly employed by authors instead of Biology, our application of the word coincides with this meaning also, inasmuch as that the primordial effects in nature are those of living bodies called by authors physiologic. This Physiology is qualified as "Universal" in order to denote that we comprehend the theory of Nature in abstract, without detailing any particulars or concrete facts.

This Physiological Theory is developed with the sole guarantee of the uniformity of Nature, and is based on the

principle of conservation alone, which asserts the unquestionable truth of the inertia of matter. It fulfils the greatest necessity of mental speculation, discovering the unity of all objective knowledge; for as the universe is a system, a theory of its activity must be universal and not partial, and if a mutual connection does indeed exist among all material changes, our reason logically theorising must arrive at *unity*. It sustains that the first effects in the world are those of vitality, from which all other material changes are uniformly derived by simple propagation of movement with conservation of energy; and it asserts that the continuity or persistency of Cosmos in its uniform actual state depends on the Supreme Power, which directly acts in organism alone. Hence the so-called physical, chemical, vital and cosmic forces are not causing agents, but mechanical results in accordance with the true law of inertia, for matter is not capable by itself alone of producing any change.

Universal Physiology, comprehending the whole theory of Nature, must study it both analytically and synthetically; from this arises our classification of its departments into two groups, Analytic and Synthetic Physiology,—the former including General and Special Physiology, and the latter Biology and Cosmology, of course in the abstract sense. Hence the following order in its division: 1st, General Physiology, which comprehends the most

abstract ideas of matter and its first analytical link; 2nd, Special Physiology, which treats of every material change in particular, in order to rectify the theories on Molar Mechanics, Heat, Chemistry, Sound, Light, and Electricity; 3rd, Biology, which makes the partial synthesis of Nature, embracing the living world alone in order to discover the combination of changes in organism; and 4th, Cosmology, which explains the total synthesis of Nature — *i.e.*, the combination of all changes in Cosmos, showing the organic origin of all phenomena, even those of so-called universal attraction, as gravity, planetary movements, terrestrial magnetism, affinity, etc.

The book opens with an "Introduction," giving the logical and physiological data necessary to develop and understand the Physiological Theory; and closes with a recapitulation of our principal conclusions.

C. C.

LONDON, *July*, 1889.

INTRODUCTION
TO
PHYSIOLOGICAL THEORY.

LOGICAL AND PSYCHOLOGICAL DATA.

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LOGICAL AND PSYCHOLOGICAL DATA.

CHAPTER I.

PROVINCE AND DIVISION OF UNIVERSAL PHYSIOLOGY.

THE mechanism of the world consists in the conservation of matter in movement. The abstract ca ısing or generating forces, as attraction, affinity, etc., which are the image of the supposed *anima mundi* of the ancient philosophers, must never more be admitted, because they are always the effect of propagation. If, sometimes, we do not discover direct propagation in a change, it is because there are indirect transmissions across invisible means. This solution, given to the greatest physiological problem, is justified in this book.

The problems which are within the sphere of Natural Philosophy or Physiological Science are exclusively mechanical or material; for those of conscious activity, or the spiritual, are of intrinsic, supersensual or supernatural resolution, and belong to the sphere of Metaphysics. Conscious activity peculiar to the mind is a necessary condition of the mental fruit called

ideas, very different from the material work of the general activity of Cosmos, which presupposes nothing but movement.

Scientific works may be either theoretical or practical; the chief aim of the former being to make discoveries, and that of the latter the application of these discoveries to the uses or necessities of human life. We group the theoretical sciences under the name of Philosophics, as their sole object is wisdom or the love of knowledge; we group the practical sciences under the name of Philotechnics, their aim being to know in order to act—*i.e.*, a practical love for doing or working.

In Philosophics it is necessary to distinguish three kinds of knowledge: first differentiating the divine from the human, and in the human the supersensual from the sensual, as it is impossible to establish any notion which comprehends at once both the Creator and the created, and in the created both mind and matter. Accordingly, we here establish the separation of supernatural from natural philosophy: the first is the science of the immaterial, comprehending Theology and Psychology; the second is the science of the material world, including Physics, Chemistry, and Biology in their abstract and descriptive sense. This science of the material world we call Universal Physiology; its departments may be classified into abstract and concrete. Abstract Physiology studies the notions or concepts of Nature apart from the objects from which they are taken—that is, the objective knowledge of generalisation. The purpose of this work, then, is Abstract Physiology, in which the word "abstract," on account of its obscure sense is substituted by the word "Universal." The aim of Concrete Philosophy is to investigate real existences of natural beings as concrete things, definite in their acts; it comprehends

Mineralogy (including Descriptive Chemistry and Geology), Concrete Biology (Botany and Zoology), Descriptive Geography and Astronomy.

The province of Abstract or Universal Physiology (that is, of these "Principles") being already determined, we will now give a slight idea of its departments, formally studying the general principles which are the base for the general theories —that is, those principles which make common reference to all natural changes, and afterwards occupying ourselves with the particulars referring to all kinds of changes which will be determined as different in their classification. From this arises our division of Analytical Physiology into General and Special: as in the analytical investigation of Nature, we will first study the general principles of all phenomena, and afterwards the variety of phenomena in particular.

Accordingly, General Physiology treats of resolving questions which are usually badly classified as Metaphysical; Special Physiology studies what is generally called Physical Theory and General Chemistry; and Synthetical Physiology comprehends Abstract Biology and Cosmology.

Without a previous knowledge of universal notions we cannot scientifically know the particular, as the latter are implied in the former. Therefore we will begin to treat the Physiological Theory by the study of General Physiology, in which the concepts common to all objects are treated of. Following this will come Special Physiology, which will study separately the theory of every class of phenomena; and finally will come Synthetic Physiology, which studies the living being in its general form of aggroupation, and the phenomenal genesis of Cosmos as the effect of vitality, so that this part is subdivided into Biology and Cosmology.

The Analytical part, then, comprehends the theories of the

constitution and activity of matter in general, the theory of Molar Mechanics, Heat, Chemical Affinity, Sound, Light, and Electricity. Biology and Cosmology, which study the synthetical abstraction of Nature, are no more than an application of these changes or mutations to the vital and cosmic synthesis —that is to say, to those engendered functions which taken together are called vitality and cosmic activity.

The material changes or mutations of organism are of two kinds: manifested or phenomenal, and non-manifested or latent. The first may be either molar or molecular, according as the movement is visible or otherwise; the molar are of two orders, contraction and reproduction. Accordingly, four kinds of functions of vitality result: contractile, reproductive, trophic (thermo-chemical or molecular), and nervous or latent. This last is the most primordial act of vitality, and from this circumstance is erroneously considered by authors as automatic. Physiological Synthesis may be either partial, referring to the living individual; or total, referring to the Cosmos. The partial synthesis may be called micrologic, and the total cosmologic. In addition to this, if we divide all objective study into descriptive and genesic, it results that Synthetic Physiology comprehends four departments: Organic Micro graphy, Organic Microgeny, Cosmography and Cosmogeny.

CHAPTER II.

PRINCIPAL CAUSE OF DOCTRINAL ERRORS.

THE conceptual elements of objective being or real nature are four: two are attributive abstractions (abstractions of an entity in itself)—substance and activity: and the other two are relative abstractions—space and time (abstractions of different entities among each other). When an entity is not defined, its four abstractions are also indefinite, and from this arise chimerical, ontological concepts: and when the entity is defined by our sensual observation or experience, then the four elemental abstractions are also defined, and from this arises true physiological concept. When this distinction is not well established, the metaphysician, influenced by ontological errors, has the tendency to pantheism and idealism, and the physicist or naturalist for the same reason usually falls into atheism and materialism. If these abstractions in regard to the Infinite Being are confounded with the finite, we then fall into the error of considering them as really existing not in the Divinity, but in themselves; and if the abstractions regarding the finite being or Nature are considered as exclusive existences, the result is the false supposition that matter is in itself alone the only principle of the Universe, and Nature then should be governed by itself alone, as is the idea of transformism.

In Physiology (comprehending the whole science of Nature) it must not be forgotten that the object pursued is partial, that this science does not comprehend all knowledge, and therefore must not deny the existence of those sciences which

treat of that which is beyond our extrinsic sensations, and that the inquiry into Metaphysics (Theology and Psychology) is of a different order from the inquiry into Physiology.

Physiology has been contaminated by the ontological errors of the metaphysicians : thus, for instance, it is a relic of realism to consider as entities or beings of separate existence the concepts and even the conceptual elements which are formed by mental abstraction from our external experiences. Thus also it is realistic to consider as separate existences every one of the different kinds of phenomena—as caloric, luminous, magnetic and electric agents, molecular forces, planetary attractions, etc.

In Psychological theory the same error is also frequently found—*i.e.*, to individualise as realities the different conscious activities, and from this results the admission of plurality instead of unity in our mental power.

There is nothing absolute in Nature; or, better to say, our understanding does not and cannot know physical unity, entity or type in absolute, either of quality or of quantity. There is no absolute material substance, no absolute activity, no absolute space, and no absolute time. We do not objectively recognise anything which may be an absolute cause or principle ; all that is physiological (Nature) is an effect or medium. Every form of material existence suffers perpetual changes, undergoes incessant mutations which are not primordial, but derived by propagation. Manifested existence depends on mutual actions among objects, and on the interaction of these with the mind from which we form the relations of the objects, and consequently all their possible knowledge. Notwithstanding this evident truth, the greatest minds occupied in scientific speculations have forgotten it when they suppose the ultimate elements or real constituents of the world, atoms, monads, etc.,

are absolute realities. Atoms are erroneously considered absolutely simple and indivisible, as if they were the last elements of the material world, the physical unities absolutely constant which by their aggregation form the Universe.

CHAPTER III.

OBJECTIVE OR COSMIC PERCEPTIONS.

THE acts of feeling and thought are symbolised in an entity which we call Mind. We say that the mind, in substitution of the personal subject, feels and thinks; the product of feeling we call sensation, and that of thinking, thought. When we think, we affirm or deny, we agree or disagree; the resultant of such a mental action we call judgment, and the capacity which contains all judgment is symbolised in the word criticism. If the result of the comparison of two concepts asserting either an agreement or disagreement in the relations which they express is a judgment, and a comparison of judgments is a reasoning, by reasoning then we arrive at inferences (inductions and deductions) and calculations in which the expressed relations are known either by perceptible sensations (categoric knowledge) or by ideas acquired from pure thought (hypothetic knowledge). The first relies upon the direct proof of experience in order to be considered as evident truth; while the second is not within the direct reach of the senses, but is warranted by the laws of thought and the rules of art which direct reason (Logic and Mathematics).

When we reason we can compare in two ways; therefore there are two kinds of operations in reasoning: one purely logical—comparison of quality; the other mathematical—com-

parison of quantity. By the power of reasoning man can foresee what he has not seen, foretell what he has not heard, predict what is going to happen. But to accomplish this supreme operation of the mind we need theories whose starting-point is in the principles which are the subject of study in this work.

The knowledge which is the fruit of thought takes thought with its laws for a means, but the primordial or fundamental ideas are always derived from intrinsic and extrinsic sensations, that is to say, from the primordial facts which our mind discovers by immediate or direct perception, they being isolated without any connection in the existent system, and so lacking scientific character. Therefore intuitions do not belong to Physiology, but to Ideology, a department of Psychology. In truth, the perception of objects is not complete as scientific knowledge until they are assimilated and classified; mental assimilation demands the ideal decomposition of objects into sensations, and classification requires the recomposition of the ideas by thought. Without these two circumstances our mind could not define or specify any object; it would only contain a vague and general idea of them. One thing is not quite definite while we are not able to refer it to one of the known classes, or at least while we cannot establish the relations fixing the similarities and differences with any of the classes already known. We comprehend the importance and necessity of classification only by noticing that all the terms of language are general, and therefore they presuppose the element of classification. Nouns express only abstract ideas of attribution or of relation; and they always imply classification in their meaning, as to name a thing or apply any term as a predicate is an act of abstraction which presupposes classification.

The total result of the process of extrinsic perception is the concept of objects in their relations with the different qualities or states of the receiving subject or mind. This makes it appear to us that the objects are contained in the mind; but such contents are only objective symbols, and thus we acquire the knowledge of objective perception, not by inference, but by the association of those symbols. It is not the eye which truly sees the object, nor is it the ear which hears and understands; it is the mind itself. Indeed, light, sound, or any one of those changes of the world which produce the activities present in the mind, is not perceived by the senses, though by a figure of speech we say to see with the eyes, to hear with the ears: what happens is that we see, hear, etc., by means of the senses, but we perceive only with the mind. The initial activity of perception depends on the interaction excited between the mind and the senses by the object; all that happens afterwards is a consequence inherent in subjective activity, association, unconscious suggestion, and reflection. We could not possess any idea of identity and consistency among objects if the mind constantly reacting did not correct the appearances of the sensations, but was strictly limited to the impressions produced by the senses. The mind is the sole thing which has the power of elaborating sensations and thoughts, in the same manner as the ovule is the sole object from which an organism can be formed.

Objective perception involves not only presentation of ideas, but also their representation—that is, the manifestation of ideas previously formed by objective sensations. Furthermore, the reproducing elements of knowledge (representation) are more important than the elements acquired in actuality (presentation). For this reason the processes of presentation and

representation are necessary at the same time in order to acquire the scientific knowledge of Cosmos (Physiology).

There are forms of representation, however, which do not involve any perception of actual presentation: such are the acts of memory and those of imagination; but even then the object may also be suggested by the senses through the act of association. Therefore mature perception involves in some manner representative activity, though in many perceptions presentation plays an important part, while in some others, being purely representative, it constitutes a special phase of mental activity in which the elements can even be combined in new forms.

The following circumstance in regard to representations is worthy of mention in Physiology. A case experienced will be more exactly reproduced the more links of connection there are among the data of sensation, as it will then be more intelligible. In fact, if the connection among the data is known, it is enough to remember the premises in order to call to mind the conclusions, if we have rational or philosophical memory; on the contrary, if the elements of mental connection are lacking, the case is easily forgotten, except by one of those irreflexive or spontaneous memories which, by a sort of unrolling of words, can reproduce them without any other connection than the immediate succession in which the words were acquired.

CHAPTER IV.

HOW PHYSIOLOGICAL KNOWLEDGE IS ACQUIRED.

No theory can be the fruit of intuition,—it is the fruit of thought; and a physiological theory must not be invented by imagination, but planned by inferences and calculations which are the fruit of reason.

Objective perceptions are the data for the knowledge of Cosmos, and our ideas of the world are conceptual, or formed by mental abstraction. The interaction of matter and mind may produce either subjective differences—qualitative ideas, or objective differences—quantitative ideas of space and time. The subject is known by qualities or attributive differences alone, and not by quantitative differences. The object, on the contrary, is known by quantitative differences or different relations, and not by qualitative differences either of substance or activity: that is, objective perceptions, which are the data for the knowledge of Cosmos or ideas of the world are conceptual, or formed by mental abstractions from sensations whose differences are only in quantity.

Matter and Mind (object and subject) can only be known by their reciprocal action (interaction); there is no state of consciousness regarding the knowledge of matter in particular which is not determined by such mutual action. Now, if we think that objective knowledge or material nature is valid, we must admit also that there is a fixed relation between its antecedents; the sensations which result from the interaction of things and mental activity must produce the same perception when the extrinsic excitation is the same. Nevertheless

errors of perception may occur either by perturbation in the means of transmission (abnormal nervous action), or by differences in the association of ideas, or else by the arbitrariness of which mental influence is capable above all in its most essential product—language,—which is so frequently fallacious. All these may change the conditions of propagation either materially or verbally, and therefore may change the antecedents of perceptions.

From this idea given about scientific acquisitions it results that our physiological knowledge is based or founded in mutual actions among objects—that is, in their relations—because all the properties of an object are finally reduced to the condition of producing effects by interaction among things, and such effects in order to determine sensations must produce some change in the organs of sense, manifesting themselves to the mind after their propagation through the nervous conductors and centres. A thing alone cannot be known or conceived, because its existence would not be the object of sensation or of representation in thought. A thing really objective, then, is a term in an infinite series of things which are in mutual dependence, as without this there is no possible form of known reality either by experience or by pure thought.

Accordingly the physiological determinations generally considered as qualitative are relative as well as those usually called quantitative. Quality directly results from the mutual action between the objects and the mind by an immediate connection without reflexion—irreflexive perception or attribution; and quantity is a relation (either numerical or of extension) among terms (which of course are not absolute) by mediate or reflexive connection—reflexive perception or relation properly so called. There is nothing, then, truly attributive in objects; as the attribution or difference of quality

is purely subjective or mental, while objective differences, on the contrary, depend on quantity, and these are material or mechanical relations. Let us, then, fix well in the mind the idea that determinations of quantity only, and not those of quality, can be deduced one from another by our mind in accordance with general laws, physiological inquiries being of that kind.

The starting-point of thought in following the process of mental *elaboration* is the comparison of intuitions; and these are of two kinds, intrinsic and extrinsic. The assertion is completely different in accordance with the class of intuitive premises of thought; the assertions inferred from intrinsic intuitions are purely mental (immaterial, spiritual, metaphysical knowledge), while the truths inferred from extrinsic intuitions are sensual or material—that is to say, physiological knowledge. For psychological knowledge the mental *ego* has in itself an exclusive right, as nobody but one's self can directly perceive the acts of self-consciousness. The limit of physiological or natural knowledge—that is to say, knowledge about extrinsic or objective things—is experience; Nature or object is equally common to the observation of all minds, and the perception of its changes is the right of everybody.

CHAPTER V.

PROOF OF PHYSIOLOGICAL DATA.

PHENOMENA or manifested changes of objects are the data for the senses, and ideologists usually say that such data may be contradictory one with another, and therefore deceitful. But all physical or natural reality is material, and its knowledge is derived from what is manifested by the senses. If the sole

proof of physical reality is sensual experience, the assertion that the testimony of the senses is deceitful is not true; in fact, the sensations may deceive us, but they are also the testimony to prove the evidence of our knowledge. The data of the senses may be contradictory if we take for a moment only one sensual datum isolated from the data of the others; for any sensual datum whatever is complementary, and needs to be rectified by other data taken by the same sense or by the others. The true distinction between what is apparent and evident in nature is that the apparent is a partial inquiry or a contribution to the total evidence. An illusion of the senses results from testing them in an inconvenient and incomplete manner, so leaving the assertion without evident confirmation.

It is clear that all sensual proof requires the reflection of thought, and therefore that all knowledge, including the experimental, is not only the fruit of observation, but also of reasoning. Knowledge is always, in fact, the fruit of mental elaboration; it is a reflective and not an immediate act; it is without any doubt an intellectual product, and not alone a sensual one, but to prove the truth in the interpretation of natural phenomena, experience must supply numerous and correct facts. From these facts of observation we acquire the separate primordial ideas which are the basis for the knowledge of nature, as without such a foundation the human mind could build only a fantastic world, and whimsically fix laws to govern it.

The power of the mind in the study of nature must be limited to discover, not to invent. Hence pure reason alone is not sufficient to form a rational theory, nor are the particular experiences (which are under the jurisdiction of the senses) sufficient to elaborate a theory, as this is a mental synthesis.

Both orders of mental activity are complementary in the acquisition and proof of physiological science; both, then, must work together to arrive at the rational conceptions of true generalisations, and to prevent us from reaching imaginary results.

Pure thought without a deep observation of phenomena can give rise to imaginary ideas alone, which are ordinarily only chimerical suppositions—at least, when they refer to the theory of nature, like the innumerable hypotheses of the Greek philosophers. But to believe in our external sensations without submitting them to the examination or proof of reason frequently produces false conclusions also; as, for instance, we could think the sun revolves round the earth if we trusted the evidence of our eyes alone.

Strictly speaking, experience is the source and proof of all knowledge of nature, but the generalisation of ideas in science is far beyond the limits of our sensual observation, which must be subordinated to the supreme capacity of the mind—reason. Thus, in a figurative sense we can say experience, supplying the particular facts as antecedents, is the mother of science; and reason, elaborating the generalisation necessary to the speculations of theory, is its mentor.

CHAPTER VI.

CONSERVATION OF ENERGY IN COSMIC MECHANISM.

To find the general law or sole synthesis of the material world has always been the unanimous desire of the great scientists, and a comprehensive law of all Cosmic Mechanism has been found in a quantitative relation. We have reached the knowledge of the following law, which denotes a relative

unity: In nature there is conservation or persistence of the same quantity of moving matter. Reason proves that the great principle of quantity called "conservation" is the true and just one, and not a chimerical aspiration of science, because, though phenomena are constantly manifested as newly engendered, it is only by an effect of the propagation of latent or potential energy. Hence such a principle of conservation, like the law of inertia, simply means that material energy is never annihilated nor created in absolute.

In apparent opposition to this unity of Cosmos, observation supplies us with a multiplicity of qualities of objects which are separately perceived by the irreflexive mind as different sensations altogether. Our consciousness, in truth, perceives the different sensations as if they were many other primordial properties, and consequently in the attributions or qualities we do not find any reason common to all objects which could explain the unity of Cosmos. Such a reason we find only in objective relations.

Let us now see what kind of relation explains such a unity. We know that the establishment of a relation or proportion of quantity needs at least two perceptions, and the act or mental repetition gives us the idea of number—that is, the difference between unity and plurality. We also know that quantity can be either discrete or continuous: with discrete quantity the combinational operations of mathematics or algebraic calculations are made; and with continuous quantity the extensional operations of geometrical studies. Both kinds of quantity may be either numerically undefined or definite; nevertheless it can be said that we see in nature infinite forms of extensional or continuous quantity, while combinational or discrete quantity supposes invariability, as abstract number is employed. Besides, extrinsic or objective perceptions can be quantitatively

compared, but intrinsic or subjective perceptions cannot be admitted to comparison under the standard of abstract number. Hence the capacities of the mind are not of mathematical application: this can be made only with the acts of the material world, which are manifested by the senses as natural phenomena, and which are collected by our understanding as a basis for natural science—Physiology—under the principle of conservation with the standard of abstract number.

All physiological energies, phenomena as well as latent changes, are the effect of matter in movement, this being always equal in its total force, energy, power or intensity. This is the true mathematical reason of the relative unity of cosmic mechanism. If there is always the same discrete amount of matter in movement in Cosmos, we can derive from such a principle all the other physiological laws which are considered by the authors as the primordial laws of Nature. Calling R and F the cosmic energies, comprehending those in a latent state as well as those manifested, we can condense this law into the formula $R = F$: that is, the resulting energy of a change equals the force employed to produce it. But this axiom of persistence or conservation of energy needs a universal complement: this is the vital or organic reason called the principle of *uniformity of nature*, which must depend on the existence of only one primordial power—that is to say, on the absolute unity of the Supreme. Hence we proclaim a true scientific monotheism, according to which only one cause of uniform involution of inert matter exists, and that is the Creator.

PART FIRST.

PRINCIPLES OF GENERAL PHYSIOLOGY.

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CHAPTER VII.

MATTER IN GENERAL.

THE terms matter and force are in reality synonymous, and not complementary; each alone truly represents the whole of an objective thing; they are neither separate nor joined, but one thing alone. Some who object, as we do, to such a distinction try to remedy it by saying that force is nothing but movement, and therefore that the only thing opposite to force or movement is mass. But mass and movement, like matter and force, are not complementary, they are inseparable; in fact, there can be no mass without movement, and no movement without mass. What, then, do these terms mean? They are nothing but symbols of concepts of mental abstractions taken from cosmic mechanism, physiological universe or material nature. Thus, when we refer to mass we mean gravity exclusively, which is a resultant of movement; but because of this we must not forget that that which may be a manifested object cannot be passive matter; that when we speak of active movement it is only to differentiate it from

relative repose, as objects are always in movement either actual or potential.

It is evident that a pure movement, separate from all bodies, is an impossibility; and we must say the same of the other correlative terms, the true proposition being that in the real concept of any of the terms, matter, mass, force or movement, the four conceptual elements are comprehended—that is to say, the four universal abstractions of objects : substance, activity, space, and time.

Force is the measure of the movement propagated from one object to another, and its intensity depends on the relation among the four abstractions here mentioned. We have repeatedly said that most authors consider matter as forming with force an aggregate or compound, and that this idea is evidently false. Nevertheless we still further criticise this point, because it has in its favour many strongly rooted opinions. Physicists suppose mass and movement not only as real elements of matter, but also as always existing each in the same quantity in Cosmos; this affirmation also, thus enunciated, completely acks foundation, because mass and movement, as well as any other relation, are susceptible of increase and diminution. Again, in ordinary mechanics mass and inertia are considered as synonymous terms, and are measured by the force of acceleration or of deviation in the movement of a body—that is, by the force which is necessary to propagate movement to a given body in order to determine in it some velocity. This use of the words mass and inertia is of course limited to atomic matter alone, with the abstraction of the differences of place or position of bodies.

Mass, movement, matter, and force are not only inseparable concepts in reality, but they are not even separable in thought. All are terms of relations among objects of sensible experience,

without any other difference among them than that which they have in abstract language on account of the omissions or ellipses which are necessary to scientific explanations. Such differences are therefore only verbal; they are only differences in words, and not in the real or true propositional sense. We need not refer back to the realism of the middle ages to see the conceptual elements of things confounded with objects of sensation; such an error is the cause of modern physicists cheating themselves in interpreting nature by their mechanical atomic theories. This error has produced the most contradictory consequences, and has given rise to endless discussions without any foundation.

Abstract force is not a real thing or individual entity which can be directly presented to the observation of the senses, or that can be known objectively by thought. It is nothing more than a definite determination by thought in the relations or mutual dependence of matter—that is, of mass in movement. Abstract force is merely a result of calculation of movements whose measure is the dynamic correlation between the antecedents and consequents of a physical change. Nevertheless, force, like physical cause, is a term of quantitative relations necessary in our discourse and in our thoughts. We must set aside the definitions of the word force given by the authors, as they all suppose it to be a real and distinct thing in nature.

The same criticism * which establishes the relativity of movement is what has served us to settle the relativity of activity, space, and time; and it only remains for us now to apply what is said about the relativity of substance to that of mass also. The measure of the mass of a body is inverse to the acceleration produced by a given force, and the measure of a force is

* This may be seen in the unabridged edition.

determined by the acceleration produced in a given mass. The ordinary method, then, to determine the mass of bodies by their weight is merely an arbitrary agreement among scientists; it is not based in the nature of anything. Moreover, the weight of a body does not depend on itself in absolute, but on its relations with others, differing according to the position of the body, and especially according to its distance from the centre of gravity of the earth, because the velocity of falling bodies near the surface of the earth is greater than if the experiment is made at a great elevation, as is proved by the oscillations of the pendulum. By inferring the ultimate abstractions of the object we arrive at the conclusion that the two universal attributions—substance and activity—are of the same nature through all Cosmos.

Although the reduction of all chemical elements to one alone is practically impossible, to assimilate all to the same substance is a theoretical necessity, because, as we have seen, all the differences among objects are quantitative; this fact truly implies the reason of substantial identity among all of these and among all their constituent parts, whether they are ponderable (atomic matter) or imponderable (progenic matter).

We have proclaimed the similarity of essence or nature in all objects, and in consonance with this idea it seems we have answered the practical question which has tormented thinkers from the earliest age of science: this is, the problem of the possibility of the transformation of matter into a single element, the resolution of which was vainly tried by alchymists. The results of the experience in chemical analysis are practically contrary to that idea of analogy in the quality of bodies, because there are more than sixty different kinds of elements which cannot be resolved into one another, and for this reason they

are considered as simple bodies within the limits of chemical analysis. This proof is not sufficient reason to consider them as indivisible or irresoluble in mental speculations, and there are many facts besides which induce us to see fundamental connections among the simple bodies. Among other facts we must keep in mind that the slightest change in the numeric relations of elements produces the greatest changes in our qualitative perceptions. It is possible to conceive the chemical species obtained by actual analysis as elemental in a series of varieties of a single substance which differ only in their relations or atomic and progenic dynamism. This possibility of descriptive analogy must not be confounded with the monomania of evolutionism, which does not accept anything as already made or created in such a state, because even if the idea of material equality could some day become a practical fact, this would not be advantageous for the speculative assertions of transformism; for the true unity of the system consists in the unity of principle and plan alone, and not in similarity in the substance and activity of material.

Neither must we confound the physiological phrase of material similarity with the ontological phrase of common substance, because this is only an abstraction born from the irreflexive experience of the fact that many different things can be made of the same material. Atoms and progenic parcels are real parts, and must be considered, as well as the totality of the Cosmos, as things in activity, and not as a passive substratum.

Material substance is either ponderable or imponderable: the former is a condensation into diminutive, indivisible particles called atoms, and the latter is the ether of the physicists, which we call progene, and which, in opposition to the indivisible corpuscles or atoms, is distributed into variable parcels. To

have a complete idea of the world in its general sense, we must make further application of the general concept of matter to its two fundamental forms separately, and afterwards consider them both together in the constitution of bodies.

CHAPTER VIII.

PONDERABLE MATTER (ATOMS).

PHYSICISTS, by their opinions on the concept of matter, are generally divided into two parties, both standing on a false basis—that of realising an abstraction: one is the corpuscular school, and the other the dynamic. The first in particular occupies our attention, for it is generally admitted by the authors.

Atomism conceives all matter as formed of passive diminutive corpuscles, endowed with extension-atoms, or, what is the same, a pure mass to which forces are aggregated, and so it pretends to explain the identity of matter, considering the atom as a common element and principle of unity. Physicists in their verbal speculations have arrived at the supposition that such material entity is simple or elemental, without distinction of quality of any kind, equal or identical in all things, and being an agent or unity in itself. According to atomism, everything should be an aggregate of such atomic entities—that is, a particularisation by means of special marks, owing only to differences of numeric quantity and geometric forms of atomic aggroupation. If they consider the atom as simple, elemental, and existing in and by itself, they recognise it as a universal being, extending this supposition to all

objective things, which according to their view are only formed by collections of atoms.

We must explain that which appears to be by that which really is; but the concept of atomism does not follow such a maxim, as it is contrary to the exigencies of science, and is so deficient besides that we cannot derive from it the explanation of physiological manifestations. Furthermore, it is notably strange that even the most eminent physicists agree in sustaining that the weight of atoms, though unknown in absolute, must be primordial, inherent or persistent under all conditions of position and combination; and chemists wholly deduce the present chemical hypothesis from such an erroneous assertion. From Dalton the hypothesis of chemical atoms has been considered as a true interpretation of the laws of definite and multiple proportions, supposing that the relations in weight according to which the bodies are combined represent the weight of the most diminutive particles called atoms. The system of atomic weights as adopted at present is based on the discovery of the law of volumes (Gay-Lussac), and chemists say that the cause of the definite proportions in which bodies are combined when they form different compounds is that all the atoms corresponding to the same species of elemental matter are equal and indivisible.

Chemists also sustain that when different molecules move to form a combination it is because they are mutually attracted—that is, they have affinity. This is not to interpret a phenomenon; it is simply to say a combination occurs "because . . ."

In the literal sense affinity is a selective force, and at the same time universally engendered; that is to say, a force inherent to matter considered sometimes as endowed with sympathetic attraction, and at others with antipathetic repulsion. This is a contradiction to the principle of the conservation of

energy and to the laws based on physiological facts. Such an impossible notion about abstract forces in mechanism must be substituted by the theory of direct impulse of matter whose variable parcels (progene) and indivisible particles (atoms) are in intermotion.

We must consider atoms as corpuscular elements having some invariable form, but with relative penetrability in their corresponding porocular spaces, which are occupied in part by the progenic parcels. Thus conceiving the atom, we can perfectly explain the phenomena presented in bodies—that is, the physical or chemical changes, or, better to say, physiological changes,—but thus we do not resolve in any manner the problem of Genesis or that of Primordial Causality. Therefore we must not think with the atomist that the properties of all bodies result from the accumulation of atoms: these are not absolute unities, they are only relative; we cannot discover in them more than a secondary activity, and that is movement which in abstract cannot be more than an idea of quantitative distinctions or relations. The qualitative distinctions or attributions of objects exist only in the mind of the spectator through the differences among the sensations there formed. Again, we must not consider atoms as in mutual absolute independence, but as dependent and subordinate particles in which there is no proper cause to produce in the natural order the combinations for the collocation of matter in the acts of vital generation. The most primordial effects of the order of the System we shall find only in ovular existence or Vitality.

If the sole mode of change in atoms is movement, in this must consist the difference among the so-called atomic properties. To determine the properties and forms of bodies we must directly refer, not to similar properties and forms of

atoms, but to their dynamic relations with progene as well as among themselves, including here also "solidity," which must undoubtedly be a product or dynamic result, and not an immutable attribute. Atoms cannot be considered as endowed with absolute or immutable extension, because in separating from one another, more or less as an effect of the changes in progenic oscillation, they acquire the control of more or less space, and from this arise thermic variations in volume. Neither can atoms move from their places without the interference of some forcing power: this means to say that the qualities of bodies which we may comprehend under the term "materiality" depend as proximate effects on the mutual action, intermotion, of ponderable and imponderable elements, and not on properties inherent to atoms. Furthermore, atoms could, perhaps, statically, completely fill space, but being then in a passive state, they could not represent or reveal anything to our perceptions; in order to produce sensations they must be in activity or movement—that is, dynamically—in which state it is impossible to imagine the absolute fulness of space. In fine, in the phenomenal world or manifested reality, even extension and penetrability (in atomic parcels as much as in bodies) are variable as a result of the changes of movement, which vary in quantity or intensity according to the energy, not of one part, particle or parcel alone, but in accordance with the interaction of all those which act in contact. The properties of atoms, then, depend proximately on their interaction with progene, and the objective primordial effects are those of vitality.

CHAPTER IX.

IMPONDERABLE MATTER (PROGENE).

SOME scientists have fruitlessly endeavoured to explain the phenomena of nature without recognising in Cosmos anything but ponderable matter. We must admit a relative, not an absolute dualism in objective things, recognising two kinds of matter, because some propagations of changes in irradiation without visible movement, as sound, light, and radiating heat, and also the latent or potential states, as electricity, can only be explained by means of an imponderable matter which we call *progene*. This matter, which is already actually admitted by almost all physicists under the name of ether, to explain light, heat, and electricity, must also be recognised as the means through which sound is propagated. (This will be explained in the Second Part.)

Bodies are complex objects constituted by the fundamental forms of matter, ponderable and imponderable. Hence substances actually considered as chemically simple, are simple only in a relative sense, considering ponderable matter alone. There is no more than a simple object in all nature; this is the interstellar progene—that is, the ultra-atmospheric meta-fluid which is generally recognised by physicists as the great ocean of imponderable ether.

We have proved the necessity of admitting in science qualitative identity among the things of nature, although this is not a fact of irreflexive experience. Reason teaches us that all objective difference is quantitative, and therefore that, within the reach of our perceptions at least, there is

nothing perceptible in Cosmos but the relations among the parts without any essential or attributive distinction. All changes appreciable to the senses—that is, physiological phenomena, progenic as well as molecular and molar—consist in changes of matter in movement derivatively produced by the mutual action of cosmic parts, the change effected being primordially in vital genesis. In the changes of nature, even in those called imponderable (progenic were a better name), there is mutual or reciprocal quantivalence: by this we mean, that the same force necessary to produce a determined consequent must be employed to effect the inverse change—that is, to produce that which was antecedent by means of the other, which before served as a consequent. Progene, therefore, differs from ponderable matter in quantity only: the quality or essence of all objects is the same.

The constitution of imponderable matter has been very much discussed, some authors sustaining that it is atomic (discontinuous), and others that it is continuous matter. Neither of these two extreme opinions can be accepted. The arguments given in favour of the atomic idea prove no more than that there is no continuity in progene. The facts observed in progenic propagations induce us to conceive progene as distributed in parcels which may exchange matter among themselves without any limit existing to such divisibility. On the other hand, the admission of vacuum is as necessary to the theory of Cosmos as is that of atoms themselves. In fact, vacuum is necessary in order that atoms and progene can move: yet it is not absolute, it is only relative; porocular space is full, although in an interrupted manner, of imponderable matter or progene in movement. There exists, then, a relative vacuum among atoms which is not permanent, but which is successively occupied and interrupted by the

constant change of position of imponderable matter—interstellar and interstitial progene in movement.

We shall see in the progenic theories of Special Physiology and Synthetic Physiology that the propagations through interstellar progene must be instantaneous, including their two forms, photothermic irradiations as the sunlight, and thermic as the invisible propagations of the planets.

The sun is nothing more than a great focus of progenic reflection, transferring the thermic irradiations which are produced in the planets by living bodies, especially by animals, into photothermic irradiations or light. The sun has no proper force of attraction or of emission; the changes of interplanetary gravitation we shall see explained in Biology by the periodicity of vital activity, especially in vegetables, gravity resulting from the transference of ultra-atmospheric radiations of progene into movements of the mass of our planet. Accordingly the hub of material circulation is the potence of Vitality, and not any force of solar irradiation nor any other of mere mechanical character, as gravitation.

This is not the opportune place to consider at length the parallel and difference between gravitation and the forms of radiating action of progene; but we will make this distinction clear, in order to avoid confusion and to relieve ourselves from combating in detail most of the arguments which have been advanced against the concept of gravitation as explained by progene (imponderable ether).

Gravitation, according to our hypothesis of progene, is a movement precisely opposite to that of radiation: it is a movement in which the resultant forces are approximated or concentrated in the direction of the propagation according to the ratio of the square root of the distance; while in radiations like those of light the resultant forces, on the contrary, are eccentric,

separating in the direction of propagation in the ratio of the second power of the distance. Thus, then, a power of radiation is centrifugal, while gravitation is centripetal; radiation is an efferent action from the forces, and gravitation is the reverse, afferent towards the forces of the sphere in action. In spite of such antagonism, the action of gravitation is not a thing absolutely different from irradiation; both are direct effects from the movements of the same intermediate agent—progene; their differences are relative, and we have effectively marked as the sole distinctive character between them that they are opposite in their directions, from this alone arising the antagonism of the interstitial effects in bodies. Irradiation being eccentric or centrifugal, acts as a repulsive force in its molecular transferences, and gravitation being on the contrary concentric or centripetal, acts as an attractive force; and from this arises the physiological analogy between the phrases *universal attraction* and *universal gravitation.*

We do not deem worthy of consideration the objection in regard to interplanetary gravitation made by Arago, who has said there is no reason to doubt that the action of gravity is instantaneous, and that if universal attraction were the result of the impulsion of a fluid, its action must need a definite time in crossing the immense distance which separates the celestial bodies. This criticism would be fatal if we consider interstellar progene of an atomic or absolutely discontinuous constitution, as atomists see gases when they are highly rarefied, but it does not in any manner affect the concept formed by us of interstellar fluid.

Other contrarieties of the hypothesis of ether have resulted from endowing imponderable meta-fluid with inherent elasticity; and, according to the authors, with this condition it should be provided with a force of pressure proportional to its density

It is inconceivable that a perfectly simple and imponderable means should be elastic, and still less that it should be dense.

Here we will make no further mention of progenic changes, because they will form the topics of Progenic Physiology in the Second Part.

CHAPTER X.

CONSTITUTION OF BODIES, ESPECIALLY OF GASES.

THE true atomic and molecular constitution of bodies exists only in their gaseous state, and for this reason the study of the constitution of gases is the most interesting. To think rightly on the constitution of gases, it is necessary first to fix the facts establishing the generalisations called laws, and afterwards to select the theoretical ideas that must be considered as evident or very probable in order to infer a logical interpretation of such empirical laws. These are three: 1st, All gases (simple and compound) change volume equally when they are subjected to the same variations of temperature and pressure; 2nd, All gases have the same fixed relation (with slight differences) between their capacity under a constant pressure and their capacity under a constant volume; 3rd, Gases are combined in very simple relations (first digits or the most simple fractions 1, 2, 3 . . . . $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$), and the resultant of a combination of gases is also in a simple relation with the sum of the components.

For the interpretation of these facts we must remember the true concept of matter and that of the constitution of bodies in general, without forgetting principally the influence of the

universal means—imponderable matter or progene. We must not admit in our reasonings the intervention of absurd molecular forces, nor of other actions at a distance.

The relations of volumes before expressed show us that gaseous bodies have their particles distributed with regularity, and that they can be considerably separated from one another in comparison with their volume. Therefore the energy of progene among the minimum particles must be equal throughout when the gas does not experience any change either of temperature or pressure, for progene being free, any change of temperature will be propagated through it to re-establish a uniform equilibrium. Thus, for instance, when the capacity of the vessel which contains a gas is reduced, the pressure will increase first on the particles nearer the walls of the vessel, but will be at once transmitted by means of progene as far as the most distant ones, and so the volume of the gas will be reduced with sensible equality in all its parts. When a gas is heated, progenic energy is propagated to it; the increase of energy may be only in the velocity of its oscillations, or in its amplitude; the former occurs when a gas is completely enclosed in a constant volume, and the latter when the pressure limiting the gas is constantly the same—that is, when the gas can freely expand according as it is heated. From this it results that every gas must have its particles more or less separated in relation with the temperature and the pressure, the intervals being equal in all parts of the same gas if they are submitted to the same conditions of temperature and pressure; but the intervals must be different according to the weight and volume of the minimum particles of every gas, because the greater is the atomic matter the greater must also be the quantity of progene, nearly in the relation as 1 : 2. This is inferred from the 46% loss of force in movement.

This idea is contrary to that enunciated by the hypothesis of Avogadro, which is that equal volumes of gases or vapour contain the same number of molecules; but we must remark that Avogadro called molecule a portion of any gas enclosed in a volume always the same for all gases. We see that this is merely a tautological explanation of the laws of Boyle and Mariotte, the same idea defined with synonymous words—that is, that all gases occupy the same volume under the same pressure and temperature. This tells us nothing of the proportion of ponderable and imponderable matter in the constitution of bodies; still less does it take into account the porocules which contain the interstitial progene, and that form part of the volume called by chemists atomic and molecular.

The adoption of atomic weights is also a conclusion contrary to the said hypothesis, for there is no exact proportion between atomic weights and the density of vapours and gaseous bodies, as is clearly seen with mercury, phosphorus, arsenic and sulphur.

Spectrum analysis has given us great knowledge, and will give us still more, on the intimate constitution of bodies—that is, on the arrangement of the particles in the different states, distinguishing the molecules from the hydrocules and orocules, and thus also differentiating the ponderable particles from the imponderable ether or progene existing among the said particles.

In order to interpret correctly spectroscopic facts, it is necessary to bear in mind that as corporeal particles, being ponderable, must suffer a continual loss of living force, so any of their movements must be arrested soon after the action of impulsive force has ceased; and this affirmation is also applicable to vibratory movements, however minute or invisible.

Therefore the interpretation of light and spectrum according

to the kinetic hypothesis of molecular vibrations is completely erroneous. In our real or practical reflections we can subtract only imponderable matter from the action of gravity, as this is the only substance capable of keeping in movement when ponderable matter is not opposed to it.

Great differences exist in the intimate constitution of gases, liquids, and solids. In liquids the molecules are not com pletely isolated from one another—they are grouped in series of twos, so forming hydrocules; and in solids the hydrocules are grouped in indefinite numbers, forming series of cells called orocules, which, when arranged with harmony, symmetry, or regular proportions, constitute crystalloid bodies.

The complete explanation and proof of the constitution of bodies belongs to the "Theory of Heat" in the Second Part.

CHAPTER XI.

INERTIA OF MATTER.

THE realisation of abstractions is nothing in material reality, and nothing can be imagined or can be conceived as resulting from it. Therefore it is as impossible to construct an object by a synthesis of abstract forces as it is by the aggregation of corpuscles absolutely *inert* or *passive*. Everything in the Universe is subordinated to the purpose and fixed aim of the Creator, who continually determines the manifested activity of Nature by organic generations; in organism the transformation of potential (not manifested) changes into actual or phenomenal is constantly produced: we can never find in any object the principle of such constant activity; this always results from the propagation of movement among objects, and this is the

true idea of the inertia of matter. Hence inertia does not presuppose want of effected, but of causal activity; the difference between the agency of life and the inertia of matter is that the former produces manifested generation, while inertia only produces propagation with phenomenal loss. Death does not signify annihilation, but a ceasing of the generation of living force which produces the manifested changes. In order that a latent change in a body should become patent, some antecedent determining such conversion is necessary; the organisms are the only laboratory or machines for such a metamorphosis, in which there is profit or multiplication of disposable force, and therefore the true Primordial Cause of activity in the natural system acts directly in them. That is to say, the primordial effect in the universe is organic generation, and from this all physiological knowledge is derived.

Inertia essentially presupposes force, instead of being an opposite term, as it appears from the etymological sense and vulgar applications of the word. In this sense there is nothing manifested that can be absolutely inert or passive, because all sensual manifestation supposes movement or material activity; thus, then, inertia must not be considered as a resistance absolutely passive. Even the definitions of the ancients express correlation between inertia and force, although, like our contemporaries, they were under the control of the same ontological error. In accordance with Newton, many authors have defined inertia as an inherent force of matter, by virtue of which matter has in itself the power to resist any change from the state of repose and of uniform rectilinear movement. Some modern authors, trying to reconcile the vulgar to the scientific sense of the word inertia, say that matter is powerless to change its situation of repose or of movement on account of the

effect of the resistance of mass—that is, of the quantity of matter considered as resistent to the communication of movement. This is neither more nor less than the definition of Newton; it declares the fact, but leaves it without explanation.

Absolute inertia, like passive matter or mass in absolute, is nothing. If for a misinterpreted illusion we try to conceive a body as isolated in absolute—that is, alone, without any connection with others, we cannot obtain even the idea of a passive body, because all manifestation results from the mutual action among bodies, and therefore a truly passive object could not be anything perceived by the senses—that is, it could not be known to us.

The law of inertia is no more nor less than the principle of conservation, enunciated in different words but with exactly the same meaning. The word inertia could be suppressed in science without being missed; it is simply a brief expression representing the facts of the principle of conservation.

The law of inertia embraces the animate as well as the inanimate world, the organism of rational as well as of irrational beings. The two forms of created activity—which are movement or physical activity, and mind or psychical activity —are both engendered, but how we do not know; we can only say that organised matter is as incapable as inorganic is of originating or producing a primordial activity.

Movement and repose are not opposite facts, but a purely relative distinction,—as we may consider any object in the universe either as in repose or in movement, according to the point we take as a standard of comparison. Nevertheless, it is a common occurrence with philosophers of nature to suppose they can conciliate in thought the absolute reality of movement and repose with their apparent phenomenal relativity. To heighten this error, some have admitted in

space a centre or point in absolute repose, to which they could refer the position of all bodies in absolute. This is no more than an expression of chimerical language, abusing its power by making it express even the inconceivable—phrases without any signification of course being the result.

Movement is the general fact that must be recognised in all mutation or material change, whether manifested or not manifested directly to our senses. It is the ultimatum in our understanding for the interpretation of phenomena and potentiality of nature; beyond that our rational experience cannot reach. Movement, being an abstraction, cannot be anything primordial: there must exist some why or wherefore in order that objects should move. Observation proves to us the constant laws of mechanical force; for if a constant reparation were not experienced in the world, all physiological manifestations would soon cease. This is the true concept of material inertia.

CHAPTER XII.

Generation of Phenomena: Cause of the System.

(Conclusion of General Physiology.)

If we are convinced that every mechanical change springs from movement, it can be in no other manner than as it is; the variability of cause and effect in the succession of phenomena is no more than apparent, because, after a profound analysis of nature, we can say that there is a perfect correlation in mechanical changes between the antecedent and the consequent, or in other words between direct or immediate cause and effect. It is an error to confound all the con-

sequences which succeed a change, with that which is really the sole immediate or direct effect from an antecedent, for in language and observation the intermediate changes between facts that appear to be in direct succession are frequently omitted. In the immediate succession of natural mutations a cause can only be followed by an effect, and in the same manner an effect must be preceded only by a cause always identical.

The validity of this assertion is confirmed by the law of uniform identity, because what is true once must be true all the time if the circumstances of the case are the same. This theoretical truth nevertheless has no practical application, because our power in rational experience is as yet very limited.

Mechanical activity manifesting change in phenomenal movements cannot be admitted as perpetually existing in the world. Phenomena in a simple mechanism cannot persist without some cause acting as a continuous agent or permanent motor, because the weight or force determined by gravity is a constant cause of resistance to sensible motion, for without such a motor gravity would soon neutralise all manifested movements. If a continued perturbation were not produced in vitality, the universe would very soon be reduced to absolute uniformity in movement withou any variation. Such would be the uniform oscillatory movement of progene, it alone would then remain in such activity, which could not be manifested by any sensation, for this supposes change, and it is not possible to perceive anything in the world if it could exist with absolute uniformity. Although material change supposes movement, if matter could exist in absolute, uniform movement, there would be no change—still less changes which are manifested to the senses ; therefore such existence could not be phenomenal

or real, nor could it even find a place in our imagination; and the universe in such a state of mere illusion, although endowed with oscillatory progenic movement, would have its ponderable matter, and consequently all bodies, in absolute equilibrium, without the slightest change either in the masses or in the particles.

The primordial change effected in Cosmos is the movement of collocation, by which the growth of living bodies is produced; and such a movement cannot result in principle from another, neither can it be produced automatically: an original generating agent, different from movement, must be the cause or reason of the phenomenal synthesis called vitality. Such a principle of change does not determine, in fact, a complete creation, neither is its effect a true transference; but it is an engendering propagation: phenomenal energy is multiplied, every newly-formed individual acquiring the same capacity as its original, which is a fact contrary to the constant correlation with loss of living force in mechanical propagations. The power of change and proper activity, then, which the Vital Principle necessarily has, must not be considered as movement, but as a Governing Intelligence. From confounding the Primordial Energy or True Absolute Cause with the effects derived from material activity, the results are the erroneous conceptions of the atomic theory and of all other materialistic doctrines, including the explanation of cosmic evolution by transformism.

There is nothing unconditionally absolute in the physical world or objective reality. In the same manner as there is no absolute passive existence or activity without substance, nor absolute system of co-ordinates in space, nor absolute measure in duration, so there is nothing absolute in nature, however complex the concepts of its abstractions may result; because all objects experience mutual action, this supposes physical

change, and physical change is always the relation between two or among many objects. Thus, then, even the word absolute itself, when it is employed in material determinations, implies relativity; it is no more than an abstraction of relativity, and not the true absolute.

Phenomena must not be directly referred by their causality to the field of atoms, but to the proximate agency of the Supreme—that is, to the ovule and its derived cellules forming the complex organisms. Hence atomic phenomena are not primordial manifestations of the universal plan, but are derived from the ovular, and those are therefore in a secondary relation to the Primordial Cause.

It is impossible to construct the System with elements mutually independent; the action of everything must be (directly or indirectly) determined by the cause of all or unity of system. In mechanism, which is the physiological existence and not the totality of the universal system, we only know the interaction or mutual determination of objects, and these not having any subjectivity, must be originated in their activities by something outside of themselves; every object, being only a member of the system, must be in accordance with what the necessity of the system requires. Thus, then, the primordial cause of change in Cosmos must be referred to something foreign to, not within, itself; it cannot be found in the physical elements, as atomists suppose, because otherwise the state of an element at any moment would not be in accordance with the necessities of the others, and in this manner there could be no system.

An error equal to that of materialistic atomism is the foundation of pure dynamism. It is not a syllogistic contradiction to suppose a world of things without extension or mutual relation like abstract forces; but such things would be inde-

pendent of one another, and then they could not explain the real world in which observation shows us the action among its parts, which form a whole, without any one thing independent of the others.

Finally, some philosophers affirm that an immutable universe, in absolute repose, is perhaps conceivable by the deductive logic of pure reason; but even if this were possible, it could not explain any of the phenomena of the real world, which in ultimate analysis presupposes beings in movement as capable only of relative change, reciprocally quantivalent intermotion.* Any other conception of matter and of the constituents of bodies would be gratuitous, and must be esteemed as useless, because it is not sufficient that the notion acquired should be, or appear to be, logically consistent; it must besides include in itself the ground of all possible manifestation.

We must relegate to the third part of this work, Abstract Biology, the complete interpretation of the mechanical principle —that is, of the so-called law of conservation or persistency; because this law is only true when it refers to the reality of the System—that is, to the Universe—but not if it is only applied to the mechanism of manifested changes or phenomenal Cosmos. Hence the conservation of material energy comprehends not only the state of active forces, but also potential or latent forces; and not only mechanical propagations, but also the changes generated in vitality, as the organisms constantly repair the phenomenal energy which is continually dissipated in the inorganic world.

* We call intermotion the interaction of objects, as it is nothing but motion.

PART SECOND.

PRINCIPLES OF SPECIAL PHYSIOLOGY.

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CHAPTER XIII.

PROVINCE AND DIVISION OF SPECIAL PHYSIOLOGY.

In order to make a correct analysis of nature, we must classify its special abstractions into logical departments, thus stating the right method which must be followed in its study. With this aim we add the following table, which shows at a glance what every department comprehends, as well as the scope of the whole.

Changes of Ponderable Matter	Visible masses: Molar Physics.	Statics.
		Dynamics.
	Invisible corpuscles: Molecular Physics.	Thermics.
		Chemics.
Changes of Imponderable Matter: Progenic Physics	Phenomenal changes, or Progenic phenomena.	Acoustics.
		Photothermics (Optics).
	Potential changes, or Progenic potence.	Electrics.
		Potential Thermics.

Notes.—1. We have adjusted the endings of all these denominations according to the most significant suffix technically employed.

2. The term "potential" is not employed in the sense contrary to actual, but as contrary to what is phenomenal or manifest to our senses. It is a relative, not an absolute term.

Let us now give a slight explanation of this table. We see

by it that the analytical abstractions of nature are grouped in three great departments, called Molar, Molecular, and Progenic Physics.

Molar phenomena, which consist in total movements of the whole mass of objects, are recognised in their form by immediate perception, that is, by the direct experience of the senses, as we perceive the equilibrium and movement of masses by two senses, touch and sight.

The forms of invisible movements which are molecular and progenic are inferred from those which are visible. The phenomena resulting from invisible movements may determine either special sensations, as heat, sound, and light, or may be known by many different sensations without any specific perception, as in chemical metamorphoses. Besides the changes here mentioned, we admit others which are not manifested, as they do not produce any phenomena either of special or of different sensations, and for this reason we class them under the head of potential changes. No sense can receive direct sensations from them: we do not perceive progene while it is confined as electricity, or irradiated under infra-luminous conditions as radiating heat. In these cases progene, in order to be manifested, must transfer its motion into one of those changes previously mentioned which are phenomenal, as sound and light, heat and chemical changes, magnetic movements and falling of bodies by gravity. Accordingly, electricity is not a true phenomenal change; nevertheless the effect of its transference into manifested changes are ordinarily, though equivocally, considered as electricity itself.

The first department, Molar Physics, must not treat of anything but visible states, which may result from translated or from return movements, and translated movements may be either rectilinear or divergent; all these movements may be

converted into one another, so that ordinary Mechanics will treat of the forms of movement and its transferences, always keeping in mind that in any molar state there is always more than one force in contribution, and therefore the study of the results of one force alone is but an imaginary calculation. The results of massive interferences are the two states of bodies which are considered by irreflexive experience as opposed to each other: one is equilibrium—Statics: the other is visible movement—Dynamics. Molar Physics treats of each of these mechanical states, studying them separately in solids and fluids, liquids and gases.

The second department is Molecular Physics. The phenomena whose movements are not perceived are of two classes: those which we call molecular are not visible on account of the smallness of the particles in movement, estimating nevertheless the consequences of a change in their relative position from which a variation in the relations of space results—that is, either in the dimension or in the composition of bodies. We must not confound these with the movements we call progenic, which, though they are also beyond the reach of our senses, as are the molecular, differ from these because they do not directly produce any change or variation, either of extension or distance, in molecular relations.

In Molecular Physics we comprehend the thermic and chemical theories. Thermics or Thermology treats of heat —changes of temperature and state, and in addition studies the relations of heat with molar movements in their mutual interchanges, that is, thermo-molar transferences. The Chemical Theory or Chemics is Abstract Chemistry, commonly called by the authors General Chemistry, in which the interpretation of the laws of chemical metamorphoses must be given, studying in addition not only the molar, but also and principally the

thermic transferences which compose the treatise entitled *Thermo-Chemistry.*

The third department—Progenic Physics—comprehends two very different sections, one treating of phenomena and the other of potential changes. We have included sound and light as progenic phenomena. Acoustics studies sound in its transmission and production, and this last is ordinarily a transference from the molar movement called vibratory. Optics, or better to say photothermics, treats of light and its molecular and molar transferences. The thermic and chemical transferences of light are very important; but its molar transference needs yet more special attention, because the action of gravity results from it.

The last section of Special Physiology we entitle Potential Physics, and it treats of potential changes of progene and of its phenomenal transferences. In this section the study of transferences is the most comprehensive, because potential changes (electricity, latent heat) can be produced by any of the forms of manifested movement or natural phenomena, and they can also be transferred into such phenomena. The electric transferences are the most important, and comprehend (1) electro-molar transferences, or total movements of bodies by electricity (magnetism); (2) electro-molecular transferences (heat and chemical combinations); and (3) electro-progenic phenomena (electric sound and electric light). Magnetic phenomena are principally considered as the most peculiar resultants of electric transference.

CHAPTER XIV.

MOLAR PHYSICS, OR ORDINARY MECHANICS.

(*Visible Movements and Equilibrium of Bodies.*)

THE most apparent phenomena in the world are the visible movements of bodies. Visible movements are of various forms, which can be mutually transferred simply by propagation of energy. It frequently occurs that two or more forces acting on the same body neutralise each other, equilibrium thus resulting. Molar physics treats both of the transmission of total movements in their various forms of direction and velocity, and of the conditions necessary among forces to produce equilibrium in bodies.

The forms of movement directly known or experienced by the senses are only those of bodies when they suffer a total change of place producing variation either in their dimensions or in the distances which separate them from one another, and such molar movements are the data from which our reason infers the forms of invisible movements. Thus, for instance, a change in molar or visible distances is the notion by which we represent in imagination the changes of molecular distances which are invisible. Thus also the propagation of movement by pressure through a liquid to points which are in condition to make known to us the mechanical law of pressure, as in Pascal's apparatus, is what can best illustrate our explanations about the conservation and propagation of invisible movements in progene.

Here it is very necessary to keep in mind that in the fundamental principle of conservation a distinction must be made between manifested or phenomenal energy and that

which is latent or potential, as the former keeps the living, actual force, while the latter preserves only movements which are dead to our sensations, and are therefore without actuality, so to speak. We must also keep in mind the continued conversion of phenomenal energy into potential in every molar movement, from which results an inevitable dissipation of living force, estimated in the best machines as almost one-half (46%) of the work employed; and as such a dissipation of force is owing to gravity, it has induced us to believe that ponderable matter has resulted from the condensation of minute parcels of progene into atoms, the volume being reduced almost one-half (46%). This loss is compensated by the actions of vitality alone; the organisms are the sole machines where the primordial production of living force is effected. Any inorganic machine is only a part of the organic system of the universe; so that when we make the general abstraction of Cosmic Mechanism we do not count more than secondary effects, in which the propagation of energy is in the consequents alone, not in the antecedents.

We distinguish two forms of visible movements—one when the body is transposed or translated, and the other when the body after being removed returns to the same position. The first is translatory, as the movements of the earth and the falling of bodies by gravity; and the second is return movement, as the vibrations of chords and of all sonorous instruments. We may generalise this fact, and make the same distinction in invisible movements, distinguishing them as translatory and return also. This will serve us for a basis in the classification of movements, as can be seen in the following table :—

Movements in regard to their duration may be either	Translatory or Return	Rectilineal, Divergent	Any of these movements in reference to their velocity may be either uniform or variable.
		Oscillatory, Vibratory	

The theory of Molar Mechanics comprehends, first, General Kinematics or Rational Mechanics, and, second, the Special Mechanism of bodies in their different states of solidity and fluidity. It is only necessary for us to mention the most general principles of Mechanics—that is, the rational axioms of forces. We must remember that the idea of movement, whether visible or invisible, is the supreme notion of all extrinsic or physiological experience, comprehending not only the phenomenal, but even what is potential in nature. We must also remember that force denotes the intensity of movement, whose measure is determined by the factors mass and velocity; mass representing the relative quantity of matter which is contained in a body, and velocity the degree of movement. If we now circumscribe ourselves to visible movements and to the state of equilibrium in Molar Mechanics, force will represent the intensity either in causing or in resisting movement; and when matter is conceived in that state of relative repose which seems contrary to movement, force is then measured by the resistance which is apparently passive—that is, by mass alone. When movements are visible, force represents the product of half the mass by the square of the velocity. This evidently results when we analyse the factors of force in ponderable matter; but in imponderable matter, when the progene is alone in the immense ocean of meta-fluid, although the force of a movement must also depend on the two factors mass and velocity, these data can only be indirectly determined by their effects on ponderable matter.

The theory of force comprehends—first, the results of one force alone, and second, the resultant of the composition of forces. In the latter case a distinction is made according as they are parallel or concurrent. The enunciation of the first

principle of the independence of forces makes reference to those cases in which they are concurrent.

Uniformly varied movement is the most important in Mechanics, as absolutely uniform movement is imaginary, and does not represent any fact of observation. The line which a body describes in its translatory movement may be either rectilinear or parabolic: rectilinear when all the forces act in the same direction in the moving body, they having thus only one rectilineal resultant; and parabolic when the forces act in different directions, so having more than one rectilineal resultant, from the composition of which parabolic movements are produced. Since this rule was settled, all mechanical problems have been resolved by means of abstract calculations. Nevertheless, mechanism in its complications offers some difficulties, which Newton proposed to remedy by means of the following laws of movement, which, rightly interpreted, are not ultimate principles, being only statements derived from the conservation of energy.

The text of the first law of Newton is simply the law of inertia, only expressed by different words. Inertia of matter is a fact common throughout all nature, and from it the principle of conservation is inferred.

Newton's second law says "the sum of movement is proportional to the moving force, and follows the direction of its impulse"; but the principle of conservation once understood, this second law, as well as the first, is nothing more than a tautological explanation, and not a real proposition.

Newton's third law expresses equality in the action and reaction of movement. This statement is very ambiguous, as it does not express the nature of the reaction: it connotes, besides, the idea of the influence of attractive forces, and, as we have set aside the existence of any abstract force, such a law is

only a repetition of the second one, which already means equality in the succession of movement, and therefore it must not be considered as a true proposition.

Newton's fourth law is that of compound forces, which is a mathematical rule to find, by means of the parallelogram, the resultant of two forces when they are concurrent. Such a rule is not an ultimate inference, but a calculation clearly derived from the principle of conservation of energy applied to component forces.

Thus, then, the law of inertia, that of the proportion between cause and effect or action and reaction, and that of the parallelogram of forces, are only different manners of expressing the same principle of conservation; but at the same time this is no more than the ultimate generalisation inferred from the fact of inertia of matter, and therefore it is not a principle of causal determination, nor an assertion of self-evident truth—its evidence results from the establishment of objective relations, including in the world not only phenomenal but also potential changes.

Mechanics, then, is based on the affirmation of the continuity of movement in space, the assertions of most authors of the continuity of velocity (relation of space and time) being erroneous.

CHAPTER XV.

MOLECULAR PHYSICS: HEAT AND CHEMICAL CHANGES.

MOLECULAR Physics studies the changes in the disposition of invisible particles of bodies. These changes are :—

1st. Changes of inter-molecular distances: heat.	Changes of temperature	Increase. / Diminution.
	Changes of penetrability or physical states	Solids. / Fluids: Liquids. / Gases.
2nd. Changes of composition of bodies.	Indefinite proportions . . .	Mixtures.
	Definite proportions (changes of molecular extension) . . .	Chemical changes.

Like all cosmic changes, thermic as well as chemical activity are effects subordinated to the principle of conservation of energy.

Theory of Heat.—The present hypothesis of heat is a contradiction to the fundamental principle of dynamism, and therefore we must qualify it as contra-mechanic, instead of calling it mechanic, as all authors do.

Heat is not a vibratory movement of the minute corpuscles or molecules of ponderable matter; and we extend this denial to the propagation of heat. Heat is propagated in two ways: by contraction, and by irradiation. According to current ideas, conduction is explained by molecular collision; but, as we have denied permanent vibration in molecules, we cannot explain by it a constant change, as occurs with heat, especially when its conduction is manifest. Interaction, or, strictly speaking, intermotion of progene, is necessary for any thermic change, recognising the permanent oscillation of progene in

the case of conservation of heat, and some progressive oscillation when there is thermic propagation. This last kind of motion is, at the same time, return and translatory—that is, an intermediate state between conservation of heat (oscillation of progene) and radiation of heat (translation of progene). We shall see that radiating heat is nothing but a factor of the diffuse course of progene, which may be luminous or otherwise—light depending on the rapidity of progenic emissions, and radiating heat depending on their amplitude: for this reason the conversion of the thermic factor of radiating energy into oscillation of progene, or true interstitial heat, most commonly occurs when there is interference between rays of light and ponderable matter.

Thermic changes are partial movements of bodies in which there is a variation in the disposition of constituent particles without chemical metamorphosis or change of composition being produced; that is to say, thermic changes are variations in molecular distances.

All authors falsely suppose at present that minute corpuscles —atoms and molecules—are constantly in vibratory movement, and that on the intensity of this depends the degree of heat. Thermic movement must not be thus interpreted.

Bodies are constituted of progene and corpuscles; the progene is always in oscillation, but the corpuscles move and are translated by progene only when a change of temperature or state occurs in bodies. When a body suffers change of state it loses or gains some quantity of heat without experiencing any variation in the temperature; the measure of such heat represents the propagation of force from the oscillatory movement of interstitial progene to the particles in order to enable them to change their relative position, and from this we infer that during a change of state there is an increase or diminution

in the energy of interstitial progene, but without any variation in the amplitude of oscillatory movement.

We have called heat many different changes, which we may classify in the following manner :—

1st. Changes of temperature, which are manifested by the dilatation or the reduction of volume—that is, by variations in the extension of bodies.

2nd. Changes of physical state by heat, in which we make reference to many concrete facts, called liquefaction, evaporation, distillation, ebullition, congelation, solidification, etc.

3rd. Thermo-chemical changes—that is, the variations of temperature manifested in chemical metamorphoses.

4th. The changes of propagating temperature, which may be either conduction or radiation of heat.

All these calorific, or we may say thermic changes, though numerous in the manifestation of their effects, must be comprehended in a unity of proximate cause; this is the oscillatory movement of progene. But we must except radiating heat, as in this the propagation is made by translatory movement.

To raise equal weights of different substances to the same temperature, different quantities of heat are necessary: such a relation is called specific heat; and in order to determine it numerically, the heat necessary to raise the temperature of a kilogram of water from zero to one degree centigrade is taken as a unity, called a calorie. Specific heat is in inverse ratio to atomic weight—that is, to the gravitating force of atoms—because the greater the resistance of the atoms to separation by oscillating progene, the smaller is the quantity of heat necessary to manifest an increase of temperature, while, on the contrary, the lighter the atoms the more heat will be expended in their progressive movements, from which the dilatation of bodies results.

The amplitude of progenic oscillations cannot increase or diminish without separation or approximation of the molecules, producing in the first case dilatation, and in the second thermic reduction; and these changes of intermolecular distances must have for a limit the moment when a change of state in bodies is determined.

The calorific capacity, or better to say calorific necessity, and the calorific tension of bodies are directly proportional, because the said tension representing the quantity of dilatation is a true molecular work manifested by the dilatation of the body; and calorific capacity representing the quantity of heat necessary to dilate bodies must be, like heat necessity, directly proportional to the bodies of molecular reclusion, which depend on the action of gravity. The unity of concept of molecular reclusion is badly represented by physicists with the word attraction, which must be substituted by gravitation. The greatest condition of molecular reclusion depends on the physical state of bodies; next to this condition is the relation of atomic weights and densities; and the degree of cohesion is also worthy of notice.

There are two different changes in the increasing and decreasing of heat; the change may be simply in the temperature without any dilatation in the body (pure progenic change), and there may also be a change of temperature with dilatation (double change, progenic and molecular). In the first case there is only a variation of the movement of progene, and in the second there is besides some translation of the ponderable particles. A calorie being the unity of measure in changes of heat, we must distinguish the calories of temperature from those of dilatation, the one being in inverse ratio to the other. Our explanation of this point is that the calories of dilatation must be directly proportional to the quantity or

resistance of corpuscular matter, while the calories of temperature are in inverse proportion to the expansive freedom of progene, which is contrary to the degree of molecular reclusion. The greater the continuous particles of a substance the greater thermic energy is necessary to separate them. For this reason hydrocules or liquid particles need more calories of dilatation to separate them than gaseous particles do, and still more are necessary for solids than for liquids. Calorific necessity or capacity of a body in a gaseous state is half that of the same body in a liquid state; and from this we derive the logical supposition that hydrocules are formed by the union of two molecules.

We constantly observe in the world transferences of molar movement into heat, and the reverse. We know that the mechanical equivalent of a calorie is 425 kilogrameters; but this cipher of equivalence is not found in practice, because the best inorganic machine cannot produce with one calorie 425 kilogrameters of living force, nor can we produce with 425 kilogrameters one calorie—only 54% of a calorie; therefore the phrase "mechanical equivalent of heat" does not take into account the dissipation of manifested energy, which is compensated in the universal system by organic generation. In spite of this, physicists pretend that all the quantity of heat which disappears in a machine is transformed into work if, as they say, the temperature is measured starting from the imaginary absolute zero. But the imaginary absolute zero cannot be more than nothing, and nothing cannot be a standard for anything.

Chemical Theory.—We shall see in Biology (Part Third) that organisms acquire their living or manifested force by molecular collocation or chemical arrangement, as vitality in the acts of organic generation primarily cause progenic currents whose

primordial manifestations are the chemical changes in the formation of organic structures. Accordingly, chemical reactions are the primordial manifestations of the change effected in progene by the Original Potence of Nature. But in any chemical metamorphosis there is a variation in the molecular extension, a correlative change in intermolecular distances being then inevitable; therefore all chemical reaction must be accompanied by some change of temperature, and from this results the constant association of the two different kinds of molecular phenomena in the metamorphosis of matter; in this lies the reason of Thermo-Chemistry. Furthermore, in a chemical metamorphosis the same thermic change always takes place, and the quantity of heat expended or absorbed is different in every combination. The affirmation of this fact is the fundamental law of Thermo-Chemistry.

Any molecular change is a mechanical work resulting from the interference of progenic actions with atomic matter, progenic energy being decomposed into centripetal energy or gravity and centrifugal energy or the force of heat, which we shall call *thermity*. These antagonistic resultants are the enigmatic forces called by physicists attraction and repulsion. The final effect of a chemical metamorphosis is a real change in molecular extension, to produce which molecular translations by means of currents of progene are necessary, and the direction and intensity of such currents result from the antagonistic action between these two forces which we have called gravity and thermity.

The so-called laws of Chemistry are empirical assertions of generalised facts. If such laws are true, they must be subordinated to the principle of conservation instead of being explained by such enigmatic suppositions as the existence of atoms of different nature and their endowment with different

degrees of an impossible elective force called by chemists *affinity*. To give a true interpretation to chemical laws, we must recognise substantial unity or equality in the nature of atoms setting aside all abstract or causing forces.

Experience has principally determined the relations of weights in which bodies form their compounds, the relation of gases in their combinations, and the relation of heat in these combinations, by means of eight laws known by the following denominations: 1st, Conservation of weights; 2nd, Definite proportions; 3rd, Multiple proportions; 4th, Volumetric proportions; 5th, Proportion of specific heat; 6th, Equivalence of heat in chemical changes; 7th, Molecular work; and 8th, Maximum work. The three first-mentioned laws mark ponderable relations, the fourth volumetric, and the other four thermic or calorific relations.

The atomic determinations of Chemics in the weight as much as in the volume of atoms are completely erroneous, because the laws in reference express only dynamic relations among the components of a chemical combination, and not fixed properties of atoms.

The force of affinity—so calling the resultant of the actions which produce a chemical change—is not a primordial or engendered energy, nor is it an abstract causing force; it is only the measure of the concrete movements of the constituents of bodies; these movements are produced by the proximate influence of more or less condensed currents of progene, which must follow the direction of the resultant of the two concurrent pressures—the external, or gravity, and the internal or thermity.

Of these progenic powers we need only practically consider thermity, omitting gravity in chemical calculations, because it is an invariable datum if the experiments are always performed

in the same place, or if the laboratories are under the same action of gravity. Chemical changes are therefore correlative with thermic variations; and from this it results that heat is the best standard for fixing atomic differences, and is the best measure of the metamorphoses of chemical affinity so called. Finally, in this is based the substitution of the secular or atomic Chemistry by the new Thermo-Chemistry.

CHAPTER XVI.

PROGENIC PHYSICS IN GENERAL.

(Determination of progenic movements.)

If the changes of ponderable matter are derived from those of imponderable, a classification of all forms of physical activity must be inferred from the different forms of progenic movements, though these are only known by imagination. We admit and recognise two fundamental states in progene, one phenomenal and the other potential; the first is manifested to us by the direct action of progene on our mediate senses, sight and hearing, and the second is only known by means of its transferences into determined changes of ponderable matter, or into progenic phenomena, as light and sound. Progenic phenomena result from the propagation of movement across progene alone; and the effects of the transference of potential movements into manifested changes, both of ponderable and imponderable matter, become the proximate cause of all phenomena in nature. When the movements of progene are transferred into a limited portion of ponderable matter, the result may be either a total movement of bodies (change of place), or only a partial movement of the constituent particles;

in the latter case the change of molecular disposition may be in intermolecular distances (heat), or in molecular extension (chemical change)—the second comprehending the first, as we have just now seen in the theory of Chemistry. If ponderable matter is infiltrated with progene in all its interstitial spaces, when a body moves both constituents, ponderable and imponderable matter, are necessarily in movement. Accordingly, molar and molecular movement cannot exist independent of similar or correlative progenic movements —that is to say, a translatory movement of a body supposes not only the translation of ponderable matter, but that of progene also, and the visible vibration of a musical instrument must be accompanied by progenic oscillation. Thus the molecular movement of dilatation (heat) implies the oscillation of interstitial progene, which increases in amplitude in proportion to the molecular separation. Thus also the translatory movement of molecules in chemical metamorphoses needs the translation of progene, and in the same manner any oscillatory movement of liquids or gases, or any vibratory movement of solids, is accompanied by the oscillatory movement of progene.

The determination of the form of invisible movements of matter is made by the rational eye of the mind, which comprehends and discovers two kinds of movements in progene (as among visible movements)—one return or oscillatory, and the other transposed or translatory.

At present most authors do not generally admit the transposition of imponderable ether (progene): they think it does not pass from the sun to the earth, that it does not pass through the wire to produce the action of dynamic electricity, that in the electric spark and in the lightning there is no change of place; and they say that light and electricity are propagated only by oscillatory movement. Such a hypothesis

is defective, as it does not well explain the facts, and it is a contradiction to the motions of Molar Mechanics, from which we must acquire the possible knowledge of invisible movements. Reason induces us to admit as a scientific necessity that which is a necessity in the function of the universe—that is, that progene must move in both ways, in progression or translatory movement, and in oscillatory movement or to and fro. The progressive movement—course of the progene—must exist in order to determine the change of position of molecules so as to produce chemical phenomena, and thus also to determine the movements of great masses which now appear to us as effects of attraction under the phenomenal forms of terrestrial magnetism and universal gravitation.

To comprehend what must be the course of progene, we must notice the extraordinary difference which exists between the movements of small bodies running a great distance and those of great masses when they move in an extension much smaller than their size. Thus, for instance, a ball shot from a gun seems to reach gradually and totally to the end of its course, while if a long bar be impelled at one end (for a short distance only) there appears to our observation to be an indirect, instantaneous and partial movement at the other end of the bar. Like this last, great quantities of fluids, as the waves of the ocean, the winds, and, above all, currents of progene, are always removed in a very limited space in comparison with the great quantity of matter set in motion. When a perfect fluid or meta-fluid like progene, which we suppose exists alone beyond the atmosphere in interstellar space, receives an impulse from one star, that impulse will be instantaneously transmitted to the others, no matter at what distance, without losing any of its initial velocity, because the intermediary substance is imponderable, and it may be said

incompressible. Such a movement is not an oscillation, but an instantaneous translation or progression, and consequently the measures of velocity which have been determined in progenic movements, as in the transmission of sensual radiations of light and in the latent currents of electricity, represent the effect of the resistance of ponderable matter to the progene in movement.

When progene is alone in interstellar space it can only follow a diffuse course, as there are no isolating means which could determine its condensation at any point. In order that progene may be condensed or rarefied it must be confined in some body—that is, it must be limited by molecular or ponderable walls; by itself alone progene cannot be the container and the contained, in the same manner as water cannot be a receptacle for water. For a similar reason progene cannot be set in oscillation when it is alone. In the space beyond molecular existence there can be no other change of place than the diffuse irradiations of heat and light, which produce thermic and photothermic propagations, and which must be equal in their velocity to the infinitely short time that a progenic emission lasts, because progene, we repeat, must instantaneously transmit any impulse to all interstellar distances.

We must now explain a point which at first sight may seem a little confused. If sound, light, radiating heat and electricity —or, to be more explicit, if sonorous propagation, luminous diffusion, thermic radiation and electric conduction—are all progenic movements, why are they so different in their manifestations? Because their essential difference is only subjective, —it is an effect of perception which exclusively depends upon the organisation of our senses and on the receptivity of our mental power; the most insignificant quantitative relations produce different classes of sensations, and from this arises

the mental distinction of qualities. We do not know material changes by irreflexive experience, for we do not perceive them as they are in themselves, but as they impress our system; the appreciation of phenomena as they are is under the exclusive jurisdiction of reason, and their possible determination is purely mathematic or quantitative, which, in a final analysis, supposes only relation either of space or time, or else a mixed relation of both space and time.

CHAPTER XVII.

PROGENIC PHENOMENA: SOUND AND LIGHT.

Theory of Sound.—The propagation of the oscillatory movement of progene claims our special attention. According to the secular hypothesis admitted by physicists, sound is considered as an effect of air-waves or vibrations of the molecules which constitute the ponderable components of the atmosphere. We must set aside the grotesque hypothesis according to which sound is supposed to be transmitted by air-waves, as it cannot withstand the most insignificant commentary; and if we, like the generality of authors, should erroneously suppose that sonorous motion is a molecular vibration—that is, a movement of the ponderable particles of air, or of any other body that transmits sound—we should then see that sound and heat, as explained in the so-called mechanical theory, would be the same thing, and therefore sound would need for its transmission as much force in mechanical equivalents as is necessary for the production and conduction of heat. But without the necessity of appealing to the exact calculation of numbers, it is clear to our reason, at a glance, that such a conclusion is very far removed from the facts of observation; and

this is still more clearly seen when the transmission of sounds is through solid bodies. There is no proportion between the molar force employed in a sonorous instrument and that which would be necessary to move the molecules if ponderable matter were the transmitter of sound to a great distance.

Sound is propagated, not by molecular vibration, but *by progenic oscillation*—or, in other words, it is transmitted by a succession of oscillations of progene. This is, then, a kind of tremulous movement, or a movement to and fro. When a body produces sound its particles are in a tremulous or vibratory movement, which impels the progene, with which they are in contact, to and fro, so that every vibration of sonorous bodies produces a progenic oscillation of the same amplitude, thus causing a very minute current of progene to ebb and flow: and such oscillations must be repeated a determined number of times in a second in order to be capable of impressing our ear by producing sonorous sensation. The limits of such repetitions, called periods, are about eight in a second as the minimum, and forty thousand as the maximum.

Such a movement is impossible in progene existing alone, because in that state any impulse is equally propagated in all directions without in the slightest degree breaking the uniformity of the tension: for this reason sound cannot be propagated, without ponderable matter, through a space in which there is only progene, as in the void bell of a pneumatic machine.

We must now give a slight idea of the character of sound. All the differences among sounds are quantitative, therefore it is very improper to consider as the quality of sound that peculiar character common to all sounds produced by the same instrument, and by which we distinguish one instrument from another. Besides this, when sound is transmitted through a fluid like air or water, only two of its

characters can be propagated: one is the intensity or amplitude of the oscillations, and the other the rapidity in the succession which characterises sound by its pitch. Accordingly all characters of sound must depend on algebraic relations and not on different geometric forms, by which authors pretend to explain the difference which they improperly call quality. Although different forms of vibration are appreciated in sonorous instruments, progene, like any fluid, cannot oscillate except in a straight line, and therefore this so-called quality of sound depends not on the form of oscillation, but on the synthetic relation of height and intensity among all the oscillations which form and propagate a sound. For this character we will substitute the name quality by the more proper one of STRUER, a word derived from the Latin *struere*, which means to unite, to put together, to pile up, to place in order, to construct; it being at the same time the root of the words *instrument* and *structure.* The word Struer truly comprehends and represents what it etymologically signifies, as the character we call Struer is not only a synthetic result from the union of elemental oscillations of different degrees of rapidity and intensity, but these conditions depend on the structure of sonorous instruments.

There are four of its characters—factors of movement—of sound, which for a clear distinction we arrange in the following table :—

Analytic character of the strongest oscillations	Rapidity or celerity	Pitch.
	Amplitude and rapidity . . .	Intensity.
Synthetic character of all oscillations	Pitch and intensity	Struer.
	Time of the sensation	Duration.

What has here been said confirms the statement that sound does not belong to Molar Mechanics; in future it must be

included in the department we call Progenic Physics, where we include light, electricity, and, with this last, the other potential changes of progene.

Theory of Light.—Light may be either colourless or coloured. The rectilinear course of progene produces colourless light when the propagation is regular or completely uniform, the rays following a rectilinear direction from the incandescent body to our eyes; such a rectilinear direction can be broken by some refracting body, but the incident and emergent rays always continue parallel. The sensation called white colour is produced when rays of light are reflected by a body in an incomplete or defective manner—that is, when part of the light is refracted or absorbed, yet follows a parallel course until it reaches the eye. From this arises the analogy between white and colourless light, both being indiscriminately called white. Progene, losing this parallelism, follows an oblique course, and propagates the emissions which compose a number of rays of light with different amplitudes and rapidity; and from this complexity is produced one, many, or all the colours of the scale seen in a complete luminous spectrum, as that of a clear rainbow.

The results from experiments with coloured light have been erroneously considered by authors as facts belonging to the most simple light. It is evident that without light we cannot perceive colours; but the inverse proposition is not true, as colourless light, like the sunshine, is seen directly by the eye. Colours are to light as struer to musical tones; colour is a synthetic character, resulting from the union of emissions which differ in amplitude and celerity.

Propagation of light is a translatory movement consisting of minute and progressive emissions of progene, therefore it must have some analogy to sonorous propagation; and in

its perception it is also pretty similar to sound, because the organ of sight is a mediate sense, like the organ of hearing. Nevertheless, light and sound differ in the form and velocity of their movement. The velocity of light across the atmosphere is so great, that it is almost incomparable with that of sound; but the difference between them is yet more remarkable when we compare the two progenic phenomena by their modes of propagation. Sound can be heard even if we have no more than one ear and this is in a direction contrary to the position of the sonorous body, and it can also be heard even if a great obstacle be interposed between that sonorous body and the ear; while light does not retrocede in its progressive transmission (if there be no reflection),—it always continues forward in a rectilinear direction between the luminous object and the eye, and we cannot see the luminous point when an obstacle is interposed between it and our sense of sight. This fact is sufficient to condemn the hypothesis of luminous undulations or oscillations; but we must be careful not to confound the theory here given with that of Newton, called "hypothesis of emissions," because we do not admit the transmission of light by particles: we repeat that emissions of light are minute impulses of progene following a very rapid course.

Those who explain light by the transversal waving of ether compare this motion to ripples in water, or to the waving movement of a long cord, or else to the vibrations of metallic plates; but in any of these cases we clearly see the cause of the undulating movement, because it is accomplished in the direction of the least resistance, which is contrary to what must occur with progene, where, on account of its homogeneity, the resistance must be equal in all parts, and therefore cannot form transversal waves.

Huyghens' geometric refutation of the fact that the pro-

pagation of light does not extend in all directions, though showing great mathematical ability, is not sufficient to save his hypothesis from condemnation; for if the resolution of such a theorem were a truth, it should also be applicable to the theory of sound, and this would be evidently contradictory to facts. Moreover, it leaves the principal question without resolution, which is, why the eye, even if placed within the cone of luminous propagation, when the pupil is not in the direction of the light, does not receive its rays, and of course cannot see the objective point of their emission.

The hypothesis of undulations sustains another error when it asserts that white light is of complex constitution, being formed of all the colours of the spectrum. The dispersion of white light into different colours by the prism is not a division or separation of the component elements, as authors state. We cannot explain such a phenomenon by differences among the supposed pre-existing colours in the white rays, as this would imply different velocities in such coloured rays, across a refracting means, which is disproved by facts from the direct observation of light, and from the comparative observation of sonorous transmission. Effectually the velocity of propagation of light and sound across a means depends on the conditions of such a means alone, and not on the character of the movements propagated. Besides, the laws of refraction themselves are contradictory to Newton's explanation of the spectrum, because it is incomprehensible that rays of the same colour, incident in different points of the prism, concur at the same place through the effect of their refraction, after light suffers such a supposed decomposition. In opposition to Newton's assertion, we must settle as a fact that the prism converts white or colourless light into coloured by changing the rapidity and amplitude of the different rays of

a progenic emission through the refracting medium, the length of the emissions varying according as the rays are more or less separated from their parallel direction. We perceive white light when the rays of one emission are all equal in the amplitude and celerity of the succession of progenic impulses; while, on the contrary, coloured light results when the rays simultaneously perceived from the same point differ in the amplitude and celerity of the succession of progenic emissions. It may also occur that though coloured rays are mixed with white in one emission, we perceive only the latter, because their intensity conceals the impression of the coloured rays; as in a simple tone we perceive only the prime-partial, because the upper-partials are feeble. White light, then, corresponds to the simple tone of the tuning-fork, while coloured lights correspond to the complex musical tones which are formed by the aggregation of partials differing in amplitude and celerity. In this parallel of sound and light we see that the colour of light is in correlation with the struer of sounds, so coloured rays of light are distinguished by the different length (amplitude and celerity) of their emissions, decreasing from red to violet, but being greatest in the invisible infra-red, which are the strongest in their thermic potence.

The study of light offers some considerations which make the concept of progene clearer and more precise. According to the progenic theory elasticity rightly has no play in luminous propagation; moreover, in opposition to what has been generally said in regard to imponderable ether, progene being a uniform means, cannot be elastic, in the same manner as its density cannot pass from zero. Progene is certainly inert, like ponderable matter in mechanism; but we must not confound inertia with gravity, as do the mechanicians, although gravity is the force by which they measure what they call

molar inertia. Progene, therefore, presupposes a principle of movement exterior to itself; activity or energy cannot be inherent to progene, in the same manner as it cannot be inherent to atoms. Molecular changes also have given us evident proofs for the confirmation of the inertia of progene, which plays such an important part in those phenomena; and these do not leave any doubt of their comprehension within the law of the principle of the conservation of energy and the relative value of progenic transferences.

Luminous movements or progenic emissions perceptible to the eye are partially or totally extinguished when progene collides with a body, because the emission may be transferred into heat; in this case the propagation changes the form of movement, and instead of progressive translation we have an oscillating whirlpool. The quantity of light that disappears is proportional to the quantity of heat produced; and for this reason black bodies, and in general those whose reflective power is very feeble, are very easily heated. Besides the transference of light into heat, Nature offers us the opportunity of observing its transference into affinity, or better to say, chemical change, and reason has discovered the important fact of the conversion of progenic irradiation into the different actions which are classed under the name of gravitation, especially the transference of interstellar movement into terrestrial gravity.

CHAPTER XVIII.

PROGENIC POTENCE: POTENTIAL * PHYSICS.

(Electricity and Potential Heat.)

THE departments of Special Physiology could be classified into two groups—one Phenomenology, and the other Potential Physics; studying in the former the phenomenal changes which are manifest in their antecedents and consequents, and in the latter the potential changes, whether latent in both terms of the change, like pure electricity, or in only one term, the other term being manifest, like electric transference. Thus, then, the study of electric changes has two parts: one which occupies itself with pure or potential electricity—that is, the study of the propagation of the potential changes of progene without transference; and the other which studies electric transferences —that is, all kinds of manifestations springing from such potentiality.

The varieties of phenomena ordinarily called electrics are not the same as electricity; they are its modes of manifest transference into one of the phenomena already known as molar movements, thermic and chemical phenomena, and sound and light. Electricity properly so called is only under the jurisdiction of reason; it is not a change directly recognised by the senses. The transmission of electricity to our nerves after its transference into nervous action does not produce any sensation of a special character; but if the electric current

* We must bear in mind that the word potential is always applied to change not manifest to the senses, so that it is contrary in its meaning to that which is phenomenal, and presupposes activity in matter, or movement.

is propagated through all the nerves it may produce all kinds of sensations, and it may even be transferred into a motor current producing muscular contractions. Moreover, the same sensations as those arising from electric transference may also be excited by molar, molecular and progenic phenomena. This induces us to recognise great analogy between nervous and electric currents.

There are two electric states of progenic potentiality—one of tension, called Static Electricity, and the other of current, called Dynamic Electricity. But to the static state of progene belongs latent heat as well as electricity; such latent heat is a change in the energy of interstitial progene without any variation in the amplitude of the progenic parcels. To the dynamic state corresponds also radiating heat or thermic radiation. Nevertheless we do not here take into consideration thermic potence, either in its static or its dynamic state, because its principles are derived from the knowledge of electric and phenomenal states. In order to make a clearer distinction, we classify the potential forms in the following table.

Static states: Tension.	Latent heat	. oscillation of interstitial progene.
	Static electricity	. conduction and rarefaction in the periphery.
Dynamic states: Propagation.	Dynamic electricity	. confined current of progene.
	Irradiating heat	. diffusion of progene.

Light, radiating heat and dynamic electricity, then, are translatory movements without any greater difference among them than in the form of progression. Radiating heat and light, which are equal in the direction of propagation, differ in the amplitude and celerity of progenic emissions; electricity differs from both in the direction of movement, because they are propagated by radiation (spheroidal form), while electricity is propagated by conduction according to the form of the conductor. There is opposition between light and electricity

also in their property of propagation across bodies, this depending on the fact that the former is a diffuse movement and the latter one of condensation.

In the *Theory of Electricity* we accept the ideas of P. Secchi, and consider with him that positive electricity depends on an excess of progene and negative electricity on a deficiency of the same fluid; considering an electric battery as a machine which condenses the progene at one point, leaving another in rarefaction, so establishing the current called dynamic electricity from the first point to the second; on this depends the positive and negative poles of the battery.

Although electricity acts in two very different modes—tension and current—both when transferred into visible movement are manifested by apparent attractions and repulsions, but they differ from one another in the duration of their effects, as the phenomena resulting from the transference of electric tension are instantaneous, while those from electric currents are continued. The two modes are correlative, and the forms of movement of the two states can be interchanged; from this electricians have already inferred that the substance in action was only one, though of different forms of movement, each manifested by a series of phenomena which differed in the appearance alone. Nevertheless, the dynamic conditions are not quite the same in these two modes, as in that of tension (static electricity) there is equilibrium, while in the electric current the equilibrium constantly fails between the two extremes of the conductor, this being the cause of the transmission of the potence between its generator, which is ordinarily chemic, to the point in which electricity is transferred into any phenomena whatever.

Electricity is capable of disturbing the position and molecular condition of bodies, and from this arises those mechanical

effects called magnetism and calorific and chemical effects. It can also be transferred into sonorous and luminous propagation. Some authors, wrongly interpreting these effects, have formed an incorrect concept of electricity. To condemn this erroneous idea, and to convince ourselves that the electric current is a true progressive movement of progene running through the conductors, we must repeat a reflection already made in progenic phenomena in regard to the defective hypothesis of the propagation of movement by means of ponderable matter alone. A superficial examination of facts has induced some scientists to form such a supposition, because in sound as well as in light, and even in electricity, movements of ponderable matter are observed near the points of their production; but these movements are only propagated to a short distance in proportion to the course which has to be traversed in such changes, otherwise a complete contradiction would result to the fundamental law of mechanism, which is the principle of conservation with its corollary inertia of matter.

Closely studying the act of production of electricity in the battery, and seeing the molecular transportations produced in chemical reactions, we cannot do less than compare chemic to magnetic phenomena, and establish a great analogy between them,—with this difference alone, that a chemical metamorphosis is like a molecular magnetism. Thermo-electric currents show us that in the propagation of heat by conduction the phenomenon is double, as there is not only the oscillatory propagation which produces molecular expansion, but there is also a flow of progene in the direction of the propagation; this is the origin of dynamic electricity produced by heat. The same reflection is applicable to all chemical metamorphoses, and for this reason we have asserted its similarity with magnetic

action. Any lack of equilibrium in progenic tensions gives rise to movements which appear to produce attractions and repulsions; therefore such movements do not represent causing forces, but forces resulting from different pressures of progene. The tendency which appears in nature to approximate bodies and particles to one another—that is, universal attraction so-called—proceeds from progenic movements which constantly exist. Let us suppose, for instance, two bodies in proximity, and with different progenic tensions, separated by a movable means like the air: a current of progene will be determined flowing towards the body in rarefaction from the air, and this means being then rarefied will cause a flow of progene from the body which is in condensation, the progenic current moving the body along with it if its gravitating resistance is overcome until it comes in contact with the rarefied body. It may also happen that the current of progene from a body in condensation carries along with it the bodies which are in its path, so determining movements having the appearance of repulsion; this will be more manifest between two bodies if both are rarefied or are overcharged with progene.

The empirical laws of electric currents and those of hydrodynamics are correlative; we observe in electricity the same characteristic properties as in liquids, such as the effects of tension produced by water through tubes, which are the same as the electric phenomena called induction. When the course of progene is interrupted, the same thing happens as when an interruption occurs in water running through a tube; in both cases a pressure is produced which is called static tension in the progene, either positive or negative according as it is condensed or rarefied.

The so-called phenomena of induction, by which the analogy between the two complementary modes of electricity (tension

and current) is principally recognised, are yet incorrectly considered as the effect of a peculiar property in bodies. So physicists define induction by saying that it is a peculiar property of bodies having electric, galvanic or magnetic polarity, which can produce the same power in other bodies without direct contact. Induction, then, they consider as polar forces acting in pairs with opposite tendencies of properties in two primordial imaginary elements. But the word induction should not be applied either to electric or magnetic results, because that would imply the idea that there are phenomena which may be produced by distant influence without the intervention of any impulsive means; it must be reserved for the elaborating process of synthetic thought which produces ideas of generalisation.

It is not within the limit of this book to go into details about the variety of every class of natural mutations, because in order to do so we should have to make simple deductions from the general or comprehensive theory here sustained, whose complement will be treated of in the next parts—Biology and Cosmology.

PART THIRD.

PRINCIPLES OF ABSTRACT BIOLOGY.

PART THIRD.

PRINCIPLES OF ABSTRACT BIOLOGY

CHAPTER XIX.

CONCEPT AND DIVISION OF SYNTHETIC PHYSIOLOGY.

SYNTHETIC Physiology comprehends Biology and Cosmology. Biology must be limited to physiological concepts, not including the knowledge about the origin and end of things, or mental activity; for Physiology must treat only of knowledge acquired by sensual data,—it must not comprehend the totality of the Universal System, but only the mechanical world whose synthesis is produced in and by living bodies.

Biology may be either abstract or concrete. Abstract Biology studies the changes of vitality without reference to any being in particular, but comprehending the generalities inferred from all living beings; while Concrete Biology studies the differences between organic individualities, first establishing the division into vegetable and animal kingdoms, and subdividing these into classes and species—that is to say, classifying organic bodies in order to study them in particular. In this work we only make reference to Abstract Biology.

Synthetic Physiology is circumscribed to the combined study of all objective changes (things of external sensation);

but that synthesis may be either total or partial, the first comprehending the whole Cosmos—Cosmology, and the second a living individual only, in which take place the changes of the whole material world in miniature—Microcosmos: this is the object of Biology. Physiological Synthesis consists, then, in a functional concurrence in which all phenomena are mechanical effects or variations arising from movement, because the vital functions are no more than inorganic changes acting in perfect concert in every organism, as they do in the Cosmic System. Accordingly, Synthetic Physiology tries to compass the combined study of the changes of Nature, comprehending the synthesis of all the changes which have been separately studied in Analytic Physiology, and producing by vitality their co-operation in a living individual and in Cosmos.

Completely separating Physiology from Metaphysics, physiologists are circumscribed to the study of material effects, to the exclusion of mental ones, and still more to the exclusion of the Generating Cause,—that is, Physiology does not include any other causes, not even in the concept of vitality, than those that are proximate up to the immediate antecedents of manifested changes in the organic functions. It is clear that in this sense we may say that the object of Physiology is purely mechanic, but this must not induce us to deny all but the physiologic; on the contrary, we must admit a True Cause outside mechanism which must be treated not physically but metaphysically. We must also recognise a mental activity separate from mechanism, its characteristics being differences of quality, and its power inexplicable by movement. We conceive the mind by the attribute of its own consciousness, and by the relation of time, without being able to predicate of it any phenomenal activity (that is, any change directly appreciable by the senses) or any relations of space. The

objective or material being, on the contrary, has as constant and indispensable characteristics the predicate of extension, implying material substance, and movement, implying relation not only of time but of space. Effectually there is an evident distinction in our consciousness between the material and the mental: the material is inert (according to the principle of conservation), and is known by the relations or predicates of quantity; the mental is active, and is known by the attributions or predicates of quality. In the former the antecedents and consequents are equivalent—there is no creation of anything (inertia of matter),—while in the latter the general conclusions are not equivalent to their antecedents, as they comprehend the universal, that is, all cases of the same kind, though they cannot be brought under our observation more than in a limited number, inductive thought then creating some ideas. In material differences there is mathematical reason, as changes of matter are propagations of movement expressed by quantitative differences or relations of space and time, connoting identity of attribution—that is, substantial identity and identity of activity (motion); but in mental difference there is no more reason than the states of consciousness, and the changes of the mind consist in qualitative differences inexplicable by movement, as in them we cannot express relations of space, and besides, they imply differences in substance and activity which cannot be known in regard to propagation of movement.

Hence, universal effects are of two kinds, spiritual and material; the spiritual are the subject of direct perception, and the material are the objects perceived not directly, but by the interactions of the senses, both with the external world and the mind; but the Primordial Cause of all effects in the universal system is one alone, which is neither subject nor

object of perception in our mind,—but is truly the Creator and Generator of all we perceive. Nevertheless the existence of God, Mind, and Matter are inconceivable as really independent of or separate from one another—that is to say, our understanding can only hold the ideal abstraction or nominal independence of any of the said entities. We cannot truly comprehend a real being which could be cause without effect, or mental subject without material object, or *vice versâ*; comprehending, of course, in this concept of universal dependence the mechanism of life as well as that of the whole Cosmos. For this reason the traditional truth of Christian revelation of the separate existence of God, Soul, and Body is and always will be a complete mystery, inexplicable by words and impenetrable to the intelligence. The problems belonging to this transcendental Trinity are beyond the limits of Physiology: they belong to Metaphysics.

Physiological explanations can never pass from the numerical equivalence of correlation between antecedents and consequents, —but this is not to assert that we find tenable the pretended scepticism of those who affirm that there is a complete mental satisfaction of causality by determining in numbers the relations of Cosmic effects. Perhaps this may satisfy some minds, but it cannot satisfy minds privileged with such intellectual development as to be able to reach the contemplating concept of a Supreme Cause, although this may only be admitted and recognised by the attributions and relations of the created, principally by the organic and psychic activity which are multiplied and developed in the Universe. No substantial predicate or relation in space and time can be referred to the Creator, as we cannot have any concept of perfection more than the material and the mental: God is inconceivable, as He cannot be either one or the other, and at the same time

must contain the capacity for both. To the Supreme Intelligence, as to any human intelligence different from our own mind, we cannot make reference more than in its activity, and this is revealed to us by the government of the Universal System—*i.e.*, by organic generation.

The interactions of a living being (as of any object whatever) are of two kinds, intrinsic and extrinsic: in the former the antecedent and consequent of the action are within the individual, they being then intransitive; while in the latter, one of the terms is within the individuality and the other is without, in the cosmic means, such interactions being transitive. The transference of one kind into another is simply by propagation. Intrinsic as well as extrinsic interactions may be either imponderable (progenic), or ponderable (molar and molecular); and in the progenic we make the distinction of phenomenal and potential, according as the changes are manifested or latent. We always employ the term potential not as the opposite of actual or active, but according to the capacity of our perception or consciousness of propagation; in like manner the term intransitive is also relative in reference to a part of the system which we can imagine separate from the rest only by mental abstraction.

We must not forget that when progenic activity is directly propagated through interstitial progene, the changes we have called progenic result, which generally produce in bodies expansive actions apparently repulsive (as thermic, sonorous, and luminous propagations); and when, on the contrary, progenic action is transferred to ponderable matter, when it collides with bodies, a contracting action results, the effect of molecular and molar changes which appear to be produced by attraction, gravitation (in its different forms, as cohesion and affinity) and magnetism. Thus, then, progenic propagations through

bodies produce the effect of dispersion among the molecules, while the effect of ponderable transference is compressive. If these different classes of changes or energies exist in Cosmos in general, and in organism in particular, forming a synthesis, any phenomenon whatever, either in Cosmos or in a living being, is the result of the antagonistic operations of the forms of progenic propagation with those of transference. Thus, for instance, a potential change like progenic transmission (electricity and what physiologists call automatic and nervous action) is a virtual result from the conflict of the potential state of progene with the movements of sound, heat, light, cohesion, affinity, gravity, and magnetism.

Physiological Synthesis cannot have a perfectly developed theory as long as it cannot mathematically explain the changes of propagation and transferences which are combined in vitality. When can this point be reached, which must be the beacon of the physiologists of the future? That we cannot calculate, because a great analytical difficulty is yet to be overcome, which now only allows us to make a very defective study of Physiological Synthesis. The molecular movements of chemical metamorphoses, and progenic movements, are not yet measured either directly or with precision, as are those of the steam-engine; hence arises the lack of fundamental knowledge of necessary data to experiment on the transferences of the different forms of energy in Cosmos and in organism. The work is as yet scarcely begun in physiological analysis, and until the knowledge of Cosmos is analytically complete we cannot take one secure step in its synthesis. Nevertheless experience has begun to prepare the field with what is called Chemical Synthesis.

Biology must spring from the irreflexive state of actuality surpassing its descriptive limits to investigate rationally the

effected genesis of organism. When it makes this progress, vitality will have the same mechanical explanation of its effects as the phenomena which are combined in it; but we must never confound such explanations with the things themselves, as the result of the process of reasoning is not the same as the genesic order of things; it is precisely inverse to that: the first effects we discover are those proximate to our senses, and consequently farther removed from the Primordial Cause. This inversion between the logical order of thought and the genesic order of cosmic activity or movement must always be kept in mind in order to avoid falling into the monistic error of evolutionism. The doctrine of primordial genesis—Cosmogony—is not physiologic, it is metaphysic.

All that has been said confirms our assertion that Synthetic Physiology does not study anything new, as the living functions are only the syntheses of changes occurring in the organic world; but because of this we must not arrive at the erroneous conclusion of materialism, which asserts that the vital synthesis results from material activity, when in the true order of succession the changes of the inorganic world are secondarily derived from the activity of living beings. We include the theory of gravitation in Physiological Synthesis, because it is not a primordial agency, but a result derived from the vital function of organism. We shall explain planetary movements, gravity and terrestrial magnetism, by progenic impulsions arising from the difference between the changes in vegetable and animal organisms, and also from the difference in both organic kingdoms during the day and night.

The field of Synthetic Physiology once determined, we must divide it into its logical departments, Biology and Cosmology. Abstract Biology studies individual synthesis in general—that is, the concept of the living element—which, being ordinarily

microscopic, may be called Microcosmos, in opposition to Macrocosmos, which is the whole world, whose synthesis is the object of Cosmology. We have subdivided Biology and Cosmology into two departments, in order to separate what is purely descriptive (relations of space) from that which is genesic (relation of activity in time), the four following departments resulting: — 1st, Abstract descriptive Biology, or Micrography; 2nd, Abstract genesic Biology, or Microgeny; 3rd, Cosmography, a general description of the world; and 4th, Cosmogeny, the effected involution of Cosmos. Cosmogeny must not be confounded with the same term in its metaphysical sense—Cosmogony, the doctrine of primordial genesis.

CHAPTER XX.

PRINCIPLES OF DESCRIPTIVE BIOLOGY: MICROGRAPHY.

FIRST of all, let us thoroughly and briefly explain the concept of living matter. In the general concept of matter we have explained the meaning of the abstract terms mass and movement, and here we must now explain their correlative organic terms, protoplasm and irritability. All the arguments employed to convince us that mass and movement are merely concepts or mental abstractions are equally applicable to the concepts of protoplasm and irritability. They are nothing but words, comprehending all the abstractions referring to organism in general; for any organised object is in reality one alone, and not an aggregation of protoplasm and irritability: it is an organism, acting of course, and not an aggregate of organs and functions. Hence protoplasm and irritability signify only the ultimate notion of living attributes, and therefore represent

the limit of generalisations in the inductive process regarding living bodies.

Physiologists, whether they have forgotten or ignored the true ideal signification of such abstract terms, have arrived at the erroneous conclusion that living phenomena are simply consequences of attraction and repulsion, resulting from the concurrence of some elemental substances, and consider nature as a continuous succession of cause and effect subordinate only to those mechanical laws which they consider as the Primordial Cause, and therefore suppose objects endowed with inherent power of transformation, which has determined in the Universe, they say, a vast process of development or evolution.

We do not tire of repeating that the mental necessity of abstractions in the formation of thought, and in its communication by language, must not be confounded with the concrete nouns which represent things existing in reality. Thus, there are not two independent beings, one static and the other dynamic: this distinction is only a verbal one, imposed by descriptive discourse, and nothing else, and therefore an organism is not a compound of protoplasm and irritability; on the contrary, living bodies are constituted of an irritable matter called protoplasm, but we must not forget that such a qualification as irritable does not represent any abstract force to produce living reactions (irritability), but the mechanical result of the combined intermotions in organism.

How many discussions lost in confusion have been sustained in all centuries by men, otherwise very distinguished in science, thinking that such a separation, which is purely verbal, is a real one!

Accordingly, there is no such thing as irritability in the sense of a vital force: the first agent we know in the sphere

of physiological actions is already a secondary one; this agent is progene in movement under its two forms oscillatory and translatory, and these movements when communicated to ponderable matter produce the apparent effects of attraction and repulsion which we have called thermic and gravitating energies. This occurs in the same manner in living as in dead matter. Translatory movement, being implied in phenomena having the appearance of molecular attraction, as cohesion, affinity and gravity, necessarily supposes the current action of progene, while the oscillatory movement of progene which causes heat must be the origin of all phenomena having the appearance of molecular repulsion. Besides, there are phenomena called magnetic which have the appearance of molar attraction and repulsion; these must necessarily be determined by translatory movement of progene, and therefore they must be considered as effects of progenic potence in all Nature, in the inorganic as well as in the organic world.

These terms inorganic and organic or organised are somewhat equivocal, as chemists and naturalists use them in a different sense—chemists including the so-called immediate principles as organic matter, while naturalists have the tendency to circumscribe organic to those complex parts of a being which are engaged in an especial function. We use the term inorganic here when we make reference to that which results from the phenomenal and substantial analysis of Cosmos, and which we may refer to bodies lacking life as well as to living bodies, in opposition to the qualification organic, which we apply only to living matter (that is, to the synthetic structures and operations of living bodies, from the most simple to the most complex) and to the complex though dead matter which can only be formed by organism. Thus the cellule (and all living matter derived from it) is organic

substance, and the generation in the individual as well as in the species is organic activity.

Authors of Biology generally make two syntheses, separating the vegetable and animal. In vegetable synthesis they comprehend reproduction (a function of visible cellular movement) and nutrition (a function of invisible molecular movement). They consider animal synthesis more complex, comprehending, besides two other functions, muscular contraction (a function consisting of a visible return movement) and innervation (a function of potential or latent change). But such a distinction between vegetable and animal life cannot be made, as it is not a true one, at least in Abstract Biology, because the vegetable kingdom is not absolutely wanting in the two functions which they consider special to the animal kingdom. Thus, then, biological synthesis must be one comprehending the four kinds of functions: reproduction, nutrition, contraction, and innervation.

We must bear in mind that mental or conscious activity must not be comprehended in real or sensual nature; ideal or psychic entity does not correspond to physiological studies, and consequently Biology must not intrude into what is exclusively under the jurisdiction of the mind, and beyond the reach of our senses.

All organism in its origin or ovular state is a minute globule essentially formed of a highly complex organised substance called protoplasm, which is usually enveloped in a membrane called cellular, and ordinarily contains a condensed nucleus. There are many living bodies whose constant state is the globular, called also cellular: such are the microscopic organisms called unicellular; but most living bodies (those which are seen by the naked eye) grow by a cellular multiplication, the numerous cellules being developed and arranged in marvellous

order, forming a multicellular organism. In these some of the cellules lose their primitive globular form, and take fibrous, tubular and membranous forms; others form a substance of uniform appearance, separating the cellules more or less from one another, being called for this reason intercellular substance, which may be either solid or liquid—in the first case forming tissues, and in the second the constituent liquids of organism.

From the chemical analysis of the ovule and its derived organic elements four simple bodies principally result—carbon, oxygen, hydrogen, and nitrogen,—which, combined with very small proportions of other elements (sulphur, phosphorus, chlorine, sodium, potassium, calcium, and iron), form chemical species of definite composition called organic principles, which may be separated and distinguished from one another by molar division, without being subjected to chemical analysis.

Particular attention must be called to the fact that all the immediate principles of organism are compounds of carbon—a fixed solid, perhaps the most perfect in its solidity —and of the gases oxygen, hydrogen, and nitrogen, which are the only ones that can be called perfect in their gaseous state. This condition, being so general in organic consti tution, must be very important, although its object is as yet unknown to us.

The substances for the formation or elaboration of organisms are of two kinds—ponderable and imponderable; the earth and atmosphere are the source of ponderable substances, and the rays of light are the source of the imponderable meta-fluid or progene.

The first and most important fact of the elaboration of immediate principles occurs chiefly in vegetables, whose leaves and other green parts containing chlorophyll may appropriate the progene necessary to produce a chemical

reaction between carbonic acid and water, in order to form hydrocarburet and eliminate oxygen. Rays of light are also necessary for the successive reactions of organism, among which the most important is dishydratation (elimination of water from a combination). In organism there are not only reactions with absorption of heat, or endothermic reactions, but also exothermic reactions, in which there is elimination of heat and carbonic acid with absorption of oxygen. These last combinations occur in organic matter which lacks chlorophyll (colouring substance), and also in all organisms when not under the action of sunlight; they are necessary for calorific reparation in organism, and for the compensation of other losses of living force, which are continually dissipated in the works of Cosmic Mechanism. So during the night all living bodies, whatever their colour and class, exhale the products of exothermic reactions, while during the day there is an excess of endothermic combinations, or chemical reduction in the green vegetation which contains chlorophyll. Inferior microscopic organisms also assist the vegetable kingdom in its work of organic formation, especially in the elaboration of nitrogenous principles. Chemical reaction of animal life is a kind of oxidation, which ends in the destruction of organic matter, thus providing the heat and movement necessary for the play of their own mechanism and that of the world in general. The constituent substances of organism, progene included, are in this manner in constant circulation, being taken from inorganic means by the vegetable world and restored to that cosmic means by animal life.

CHAPTER XXI.

PRINCIPLES OF GENESIC BIOLOGY: MICROGENY.

ORGANIC genesis comprehends individual evolution during the time an organism preserves its existence, and reproduction of species when the multiplication of beings is produced.

Individual evolution may be summarised in the three following propositions :—

1st. The vegetable world produces transferences of progenic energies propagated from the inorganic world into molecular energies, while the animal kingdom transfers the progenic and molecular energies which it draws from the vegetable world into molar energies, and restores to the inorganic world the progenic power, which was transferred into molecular by vegetation.

2nd. In both living kingdoms such acts have chemical metamorphosis as the first manifestations of vitality, whose force is measured by calories, and therefore the calories must also serve as a standard of comparison to determine the relative quantivalence of vitality. This concept is indispensable for the progress of Biology, and will be made by taking as a basis the law of maximum work when we discover the transformations which take place in every being, and the degree of stability in its composition.

3rd. The potence which is the limit of our physiological investigations is progenic; admitting and recognising that the Generating Cause (Creator) constructs organic structures by means of currents of progene in the same manner as the inorganic combinations are formed, because at bottom organic

as well as inorganic reactions are only material combinations or changes in molecular extension.

And what is the interaction between the Generating Cause and progene? This is a metaphysical problem. Physiology only investigates the successive changes which are effected in organic structures already formed. Neither can the selective organising power of vitality, which is the sole cause of promotion in nature, directly operate more than in living bodies; nor can an organism be formed by only a transmutation or transference from phenomena or material changes. Vital power in itself must not be included in the physical investigations of the successive changes of the Universe, because we cannot know by the senses, nor can we derive from phenomena alone, the knowledge of the Primordial Cause which constantly perturbs Nature in its well-ordered concert. We must not confound the physiological concept of Cosmogeny with the primordial genesis of Metaphysics, for this doctrine has nothing to do with objective sciences.

Organism by such a power of collocation, which determines its reproduction and development, needs ponderable matter to constitute its tangible structures, and imponderable matter to employ as a mechanical means in transferences or indirect transmissions. In this manner organism is the origin of all natural phenomena, realising a work of production of living force at the expense of potential energy in order to repair the dissipation of manifested energy in those partial systems called mechanic. Effectually living bodies appropriate cosmic potence (latent progene) and surrounding matter to form organic structures; and to generate such a complicated collocation of material it is necessary not only to assimilate ponderable matter, but to increase the progenic energy which is freed in the moment of decomposition.

We can show at a glance the difference between mechanic and genesic work by means of brief formulæ, representing by small r the resulting living force of change, and by small f the living force expended. Then we have the formulæ :—

$$\text{Mechanical work, } = M, \text{ is } r < f;$$
$$\text{Genesic work, } = G, \text{ is } r > f.$$

And representing by capital R and F the sum of the resultant and expended forces in the whole Cosmos, including potential state, we have

$$\text{Cosmic work, } = C, \text{ is } R = F.$$

We know by mechanics that the work of any transference may be presented in round numbers thus : $r = \frac{f}{2}$; and therefore, with the guarantee of the principle of conservation of energy in the universe, we infer the formula of genesic work in round numbers $r = 2f$. This is the formula of the great secret of Nature, as it represents the antagonistic and repairing action of mechanical dissipation. The total work of Cosmos, comprehending both $\frac{f}{2}$ and $2f$, which we represent in a whole by R, may be condensed in the formula $R = F$, that is, conservation of energy. In this last formula and principle we must take into account the constant conversion of living force in mechanism into latent by the determined resistance of centrifugal oscillation and the centripetal pressure of progene in ponderable matter—that is to say, by thermic potence and principally by the resistance of gravity.

Mechanical or artificial synthesis must not be confounded with biological or natural. The difference does not consist in the possibility of producing any change whatever. When a chemist combines carbon, hydrogen, oxygen, and nitrogen, to form immediate principles, he cannot do it as an organism, because he needs to employ a living force greater than the

resultant. In the same manner, if a chemist in the future should be able to accumulate the immediate principles in order to form protoplasm, it is certain that the work then produced will be under the same mechanical condition, that is, according to the formula $r < f$ or $r = \frac{f}{2}$—phenomenal resultant about half less than employed force (excluding that which is latent). A chemist will never be able to do that which is done by an organism, to elaborate organic matter with the formula $r > f$, or $r = 2f$—that is, phenomenal resultant twice as great as the expended living force: this is a problem which Chemistry cannot resolve, any more than Mechanics can ever resolve the problem of perpetual movement, which is a cosmic work according to the formula $R = F$—resultant equal to the expended force. This is sufficient to set aside all transformistic ideas which try to explain the origin and evolution of Nature by matter alone, the only principle which transformists admit in the Universe.

Many scientists believe that, in the future, chemical synthesis will be able to explain organic generation, basing this belief on the sole reason that they expect to elaborate all the immediate principles of organic bodies. But this would not be an organic synthesis; it would be only the first link in the chain of successive analysis. Furthermore, even if we suppose that the chemist of the future in the laboratory can reach that point where he can associate the immediate principles to form a complete organic structure, is it logical to deny an elaborating intelligence to the natural laboratory of a living body when we necessarily admit it in the artificial one? Such a primordial organising intelligence is not, in truth, perceived by the human mind, because no one can be conscious of another's intelligence; but it must be conscious in the Divinity itself, it being contradictory to suppose an unconscious intelli-

gence, and in it alone are the purpose and finality of objects or natural beings.

The conditions of the cosmic means are never complete or perfect for the development of an organism, as in the successive intermingling phenomena of Cosmos there is always some deficiency; and so in a finite number of objects we never contemplate absolute qualities, which can be attributed only to the Infinite. The Infinite alone can be true, good, and beautiful in absolute; only the Universe as a whole is a true, good, and beautiful system in absolute: one part alone, as the living body, cannot be more than relative in all and for all.

In General Physics we have demonstrated that all forces are measures of resulting movements, and that all physiological laws express only relations among the effects of Nature; neither forces nor mechanical laws are generating causes which could produce primordial effects. It is therefore a pretension not to be realised, that tendency of modern authors of Physiology to explain all natural phenomena by variations in the structure and configuration of bodies; otherwise we should only have to invert the terms of the phrase, and then say that the formation and configuration of organic structures are explained by themselves. But this is evidently false, because the greatest analogies in the germs of organism correspond to the greatest individual differences in their ulterior development, that is, in the phenomena of their succession.

The collocation of matter in organism is an inconceivable change; it is completely opposed to the fact of inertia of matter, and is therefore an action of immaterial influence. Effectually, by propagation of movement alone we cannot construct any organised body, even theoretically, because, as

we have already seen, in it the contrary happens to what takes place in an inorganic machine: there is a conversion of latent power into manifested, from this resulting the generation of actual and disposable forces, instead of the dissipation of living or phenomenal energy, as we see constantly produced by any pure mechanical means, complicated and perfect though it may be.

The power of generation or of collocation in organism is metaphysical; nevertheless we have sufficient reason to declare fully that there is no possibility of explaining the construction of living matter more than by the influence of an Intelligent Cause, which cannot be perceived by our consciousness. The generation of potence which directs the collocation of organic principles in the construction of a living body is as enigmatic as the creation of inorganic material.

Cellular Multiplication.—A complete exposition and discussion of the different doctrines of organic generation would be almost interminable, but we will confine ourselves here to mentioning only the principal ones, and these as briefly as possible. All may be comprehended in two groups: one embraces those pretending to give a genesic explanation, or discover the original mystery by expressing vain words representing abstract forces—as biontologic animism, vitalism, directing and creating force, vital affinity, and so on; and the other group comprehends the descriptive explanations of the formation of new cellules, as the so-called cellular and blastematic theories.

Some histologists, of the French school in particular, sustain that among the morphologic elements of organic tissues there are semi-liquid substances which almost always contain elements of new formation which they suppose to be formed by a kind of free condensation of this semi-liquid

they call blastema. Those who sustain this free cellular formation admit it in the following cases :—1st, Generation of the reproducing elements (male and female) ; 2nd, Formation of the first elements of an embryo ; 3rd, Generation and regeneration of epithelium ; and 4th, Generation of the greater part of pathologic neoplasm.

The cellular theory is principally held by the German school, and is to-day the most extended throughout the world. Its propositions may be expressed in the following terms :—1st, The cellule is the characteristic and pre-existent element of all living forms, the succession and conservation of vitality being linked to it; 2nd, The nucleus is the part which contributes most to sustain and multiply the living elements ; 3rd, The protoplasm is the part which gives to the cellules their special characters ; and 4th, Every cellule of those forming a complex organism is an individuality which possesses in itself its own activity, from which its functions emanate.

This last proposition expresses as erroneous a concept of the cellule as does that of physicists and chemists about atoms. This parallel once made, the same arguments which were employed against modern atomism is applicable here. Thus the cellule is the concept of a mental abstraction, by means of which it is represented in language as a simple element always analogous and constant in all living bodies—thus stripping the cellule, which has a true cellular figure, of all that is particular in its real or concrete existence. So that reproduction by excision of the protoplasm is admitted, although this may be under a diffuse, asymmetrical and perhaps semi-liquid form. On the other hand, without delaying ourselves to investigate the existence and functions of blastema, it is sufficient here to remark that the two schools,

French and German, do not differ essentially in their fundamental concepts, and that both are contradictory to the true principles of Physiological Theory, as they tend to inculcate independence among the parts of the System, so sowing the unsound seeds of transformism.

All living beings, elemental as well as complex, are subject to a fixed determined evolution, being necessarily born from a germ; our organism, as well as every one of the living elements which constitute it, must be engendered in direct succession: *omne vivum ex ovo=omnis cellula a cellula.* We recognise the truth of this assertion of the cellular theory, but we interpret the term cellule in the most extended sense according to abstract signification, including in it even the free masses of protoplasm; although in general, especially in superior beings, the generating elements have their own form more or less like a typical cellule.

After birth all individuals follow three successive stages during development—growth, fixed condition, and declining to death. Growth depends on the sum of the interaction of constituent elements producing an increase of the anatomic elements already existing, principally by new elements formed by multiplication of those pre-existent. The form of organic growth explains the other two stages in the evolution of life, because they grow in their totality relatively more on their surface, as the ratio of the cube to the square. The molar work also, principally in animal life, is greater in proportion to the growth, without increasing the ingress of matter; and besides the constant diffusion of liquids through the membranes, leaves mineral substances incrusted in them, eventually producing their true mineralisation, which decreases their endosmotic power, and therefore their activity for the interchange of matter.

PART FOURTH.

PRINCIPLES OF ABSTRACT COSMOLOGY.

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PRINCIPLES OF ABSTRACT COSMOLOGY.

CHAPTER XX.

PRINCIPLES OF DESCRIPTIVE COSMOLOGY: COSMOGRAPHY.

DESCRIPTIVE studies are not fruitful in abstract considerations; nevertheless, as in Biology we have mentioned the most general data of organic elements, referring especially to the best known cellular type—the ovule,—so in Cosmology we will recapitulate the principal generalisations, inferring them from the study of our planetary system, but particularly from the earth; although in addition to this something must be said of the relations, analogies and differences between the earth and the celestial bodies, more especially with the sun and moon. We will commence with the earth, which we will consider only in its totality.

Among the Greek sages we see the idea of the rotundity of the earth already indicated, contrary to the irreflexive belief of almost all humanity up to the sixteenth century. But no practical demonstration was made until the modern age, when Magellan (in 1520) sailed from Europe to Asia and back again by doubling the South American promontory. It is well known to-day that the earth is an oblate spheroid,

whose equatorial radius is 6,377,398 metres, and whose polar radius is 21,318 metres less, so we see the equatorial diameter of the earth is about 8,000 miles (12,754,786 metres). The density of the earth, according to Aubinson, is from 5 to 6, but the average density in the superficial layers of the earth being from 2 to 3, it has been supposed that in the interior of the earth there are very heavy substances. We must not forget that the nearer a body is to the centre of the earth the weightier it is; therefore this condition must be taken into consideration in the true relation of densities at different depths. The temperature of our planet is very variable to the depth of twenty-seven metres; but beyond that it can be said that there is constantly a fixed temperature, the thermometer always registering nearly 12° centigrade at twenty-eight metres, the temperature increasing in a uniform progression of one degree for every thirty metres of descent; while, on the contrary, the higher we ascend over the surface of the earth the lower the temperature becomes.

In order to simplify the description of our planet, it is convenient to divide it into three parts—the surface, the exterior or atmosphere, and the interior. These we may call in correlation mesogeos, exogeos, and endogeos. Mesogeos is the irregular surface of our planet, and in its study we only indicate the principal points concerning the distribution of land and water. The highest points of the earth's surface are generally less populous in living beings than the middle heights, and the most depressed parts are covered with water, in which pullulates animal life in particular. At first sight there seems a great disproportion between animal and vegetable life in these three regions, which naturally serves to unbalance or perturb cosmic functions.

We should pass far beyond the limits of this work if we

were to explain here the concrete terms referring to the different objective forms of our planet, as seas and continents, mountains and valleys, etc., so we shall restrict ourselves to the data needed for our abstract inferences. We must first notice the vast extent of water on the earth's surface, and its irregular distribution in relation to dry land. It may be said that the greater part of the earth is covered with water—about eight parts water and three parts land—that is, almost three times as much water as land. The dry land principally occupies two opposite sides of the planet, forming in one part what we call the Old World, or Eurasia and Africa, and in the other the New World, or America (North and South). There are other portions of dry land less vast, which are called islands, and which in many cases form archipelagoes, the most important of which is Oceania.

The distribution of land and water is very irregular, water preponderating in the southern and land in the northern hemisphere in the proportion of three to one. It is also worthy of notice that the depth of the sea is greater than the height of the mountains—a fact which still further increases the proportion of the surface of the earth which is covered with water. The uppermost layer of the earth is generally "made ground," that is, a thin layer of soil ordinarily modified by the artifices of human necessities; but beneath this is what is called subsoil, which is very commonly exposed to view by the denudation of waters and by artificial constructions, and is seen by comparison to be of many different kinds, as calcareous rocks, sand, chalk, clay, etc. Soil and subsoil may be classified as sedimentary and crystalline; the sedimentary is of aquatic origin, formed by the precipitation of dissolved substances, and the crystalline is supposed to

have an igneous origin. The state of each in particular is the object of the concrete science of Mineralogy.

Exogeos or atmosphere is a gaseous mixture, being principally constituted of nitrogen and oxygen in the ratio of four to one. It also includes in its composition aqueous vapour, carbonic acid, and a multitude of microscopic corpuscles, organic and inorganic. This mixture, moreover, besides being complex, is very variable in the proportion of the mixed elements according as it is day or night, and according to season, temperature, winds, height, etc. Air is nearly eight hundred times lighter than water; nevertheless the influence of its weight over other bodies is a matter of great importance, because its height (not yet precisely determined) is more than 100 kilometres, and determines a pressure on the surface of the earth which, measured by the mercurial barometer, is equal to a column of 76 centimetres, with slight variations of some millimetres. The knowledge of the succession of more or less regular barometrical variations, as well as of the movements of atmospheric translation (winds), does not belong to cosmography, because it presupposes evolution in time and explanations of the reasons of such changes—cosmogeny.

We know that the material of which the earth is composed is arranged in layers or strata, which the cutting of any section shows in a succession one above the other. To enter into details of endogeos about the structure of these layers is to invade the province of a branch of Mineralogy called Geology, which is a concrete science. The only important fact we need treat of here is that deduced from an indication already referred to about subterranean temperature,—and that is, that if the temperature increases regularly in relation to the depth or distance from the surface, it is clear that at the depth of one hundred kilometres (equal to the height of the atmosphere) the

heat must be sufficient to melt all rocks, and therefore the greater part of the interior of our planet is in a state of fusion, the solid crust being relatively very thin. In the constitution of Cosmos the earth is no more than a planet of secondary magnitude; let us now examine its principal relations to the celestial bodies, especially to the sun and moon, as the sun is in the focus of the ellipse described by the earth in its orbit and annual revolution, and the moon is a satellite which revolves round the earth. Both by their reflexion greatly influence the changes of our planet, principally in the terrestrial fluids, air and water, and above all more directly on the meta-fluid or progene existing in porocules or the interstices of bodies. We have already indicated, and we will clearly state in the next chapter, that we must not consider the sun as the prime motor in the production of the terrestrial phenomena.

The idea we form of the sun by irreflexive observation is very deceitful. When viewed through a coloured glass it appears like a white disc perfectly circular, whose diameter does not seem greater than fifty centimetres, and whose surface appears perfectly homogeneous; and furthermore the solar disc seems to move from west to east, following a curve whose centre is the point on which the observer stands, and whose extremes touch the visible horizon.

We know that the more distant an object is the smaller it appears. Thus, calculating the distance of the sun from the earth as about ninety millions of miles in round numbers, the true diameter of the sun is inferred to be more than one hundred times greater than that of the earth; the difference between the diameter of the sun and its distance from the earth being almost in the same ratio, 1 : 100. To form some comparative idea of these relations of size and distance, let us imagine a sphere of one metre in diameter, at a distance

of one hundred metres, to represent the sun, and a little ball, one centimetre in diameter, to represent the size of the earth and its relative position to the sun. Accordingly more than a million balls like the earth would be necessary to make a sphere like the sun. But perhaps we can acquire a clearer idea of the extraordinary dimensions and distances referred to by the following calculations. A ball shot from a cannon, moving uniformly with its ordinary velocity, would take about thirteen years to reach the sun; and if we suppose the ball diametrically crossing the sun, it would take more than a month in passing to the other side, while it would need only about seven hours in crossing the earth's diameter. We can further acquire some idea of the distance of the earth from the sun when we consider that a train running at the rate of thirty miles an hour would take about 350 years to accomplish the distance.

Telescopic observation reveals a fact worthy of mention. The sun has spots, which appear and disappear every fourteen days, reappearing on the eastern edge of the disc about fifteen days after disappearing from its western edge. This regular movement of the spots shows us that the sun is in rotation, and that this rotation must be accomplished in about twenty-six days. From this we infer, in accordance with the principles of our Physiological Theory, that the sun needs a continent with living matter in order to produce such a rotation; but comparing it with the earth, we must suppose that the ratio marking the difference between land and water in the sun is much greater than that of the earth, and we must deduce from this that the great reflecting power of the sun is owing to the extraordinary extent of surface covered with water. We must also explain the lack of orbital movement in the sun by the fact that the proportion of its surface on which vegetation can exist being relatively small, the force of propulsion emanating from it is not sufficient

to counteract the resistance of the solar atmosphere, and so only a rotary movement results.

The moon, like the sun, produces many deceitful appearances, among which the most surprising are the different forms it presents during its successive stages; and we see that every $29\frac{1}{2}$ days the same phases are repeated. Nevertheless it is demonstrated that the moon is an entirely round or regular sphere, and that such phases depend on the greater or less surface which reflects the sunlight. Its distance from the earth is, in round numbers, something more than 300,000 miles (about 380,000 kilometres)—that is, about three hundred times nearer than the sun, and therefore a distance almost equal to the third part of the solar diameter. Accordingly the space between the earth and the moon is only sufficient to accom modate a body twenty-seven times smaller than the sun. The diameter of the moon is almost one-fourth ($\frac{3}{11}$) that of the earth, and its size is forty times less. The received opinion of most authors is that the moon has no atmosphere and lacks water, and consequently cannot contain living beings; but from the general principles laid down in this Physiological Theory, we infer that the moon in order to accomplish its orbital and rotary movements requires life, as does our own planet. It is not possible to determine the forms of living matter, but we have sufficient reason to affirm its existence.

Analogies exist between all the other heavenly bodies and the sun, the earth or the moon, but their study is particular or concrete. We only need to know as a general fact that the differences among all of them are not absolute, and the transitions are graduated in such a manner that, relying on the late spectroscopic observations, we can proclaim the analogy of the constituent material without any other difference than in the proportions of its components, and thus can add that

in all the Universe perfect harmony reigns in the descriptive relations—those of space, as well as in the genesic—those of time. This point, Cosmic Involution, will be elucidated in the next chapters.

CHAPTER XXIII.

PRINCIPLES OF GENESIC COSMOLOGY: COSMOGENY.

(A. General concept of Cosmic involution.)

PHYSIOLOGY presupposes attributive identity (only one substance in activity or movement), the differences being due only to relative changes of space or of time, or else of both. The only possible knowledge of nature depends on the condition that all change is a transformation. Matter changes by the union or separation of parts, but through all these transformations we must suppose that material substance is always identical; and we may say the same in regard to movement, which may be distributed in greater or smaller masses, in a form either manifested or latent; but material activity is always movement. Thus the Great Architect, with His true purposes of goodness, beauty and harmony, directs organic constructions, engenders in them disposable energy and phenomenal movements, governs the course of cosmic material, but without changing the total quantity of mass in movement— that is, without ever newly creating or annihilating. He only engenders relative metamorphoses in the redistribution of the same quantity of mass in movement. The concept of conservation of energy or movement is entirely different from the continuation of the actual state of the things in the Universe: the former expresses a fact derived from the true

creation, while phenomenal activity is constantly engendered by the transformation of potential energy in organisms under the direction of the Primordial Motor. The work directed by the Creator not only preserves the quantity of mass in movement in its mechanical relations, but the persistence of the Supreme purpose in the good and beauty of its execution is denoted by the *uniformity of nature.* This ultimate postulate is presupposed before any calculation or determination of the quantitative relations are made; it is directly induced from the qualities or subjective differences, and for this reason we may say that the postulate *Uniformity of Nature* is the fundamental principle of attributive abstractions, while the principle of Conservation of Energy is the fundamental law for the relations or objective differences. Accordingly the true idea of conservation or persistency in universal mechanism presupposes that the partial forms of the enunciation of that principle are erroneous, so that we must not say there is conservation or indestructibility of mass in the world because the quantity of mass is variable; neither can we affirm the conservation or indestructibility of abstract movement because the quantity of existing force, considering this separately from mass, is not always the same, but varies like any partial relation.

Without the evidence of the principle of successive continuity and uniformity in nature between antecedents and consequents Science could not infer its great prognostications: it could not determine by the present state of things either the past or the future, as there is no doubt but that our scientific calculations would fail if there could actually be new creation or annihilation in the factors of Mechanism. But it is impossible that the regularity of the established and necessary order in Cosmos should fail, because, the work of the Almighty

being true, good and beautiful in absolute, it could not be otherwise than as it is.

In the comprehensive theory of Cosmos we omit the intervention of any agent acting as causing force, as we have done in the theory of Analytical Physiology; and in Biology also we deny the intervention of any special force in life. In this manner we dethrone the gods of the scientific Olympus, and admit only the One of the most elevated rank—the Directing Power of Vitality, which cannot be other than the Creator. Force must never be considered as an abstraction from objective things; mechanical force is not an absolute and primordial cause of Nature, but simply a measure, and therefore it is a relative determination of quantity, an effect which becomes at the same time the proximate cause of manifested actions, so that it is a secondary cause in the successive changes of Nature. Force expresses the determination of the quantity of movement propagated in a physiological change, or in the changes of a partial system, as occurs in the synthesis of life. If we conceive force in a metaphysical as well as in a mechanical sense, it would become an equivocal term, representing then, in the metaphysical signification, the True Cause, the Primordial or Engendering Potence of Vitality; because, if we prefix to the word force the adjective primordial, we indicate what the Divinity does in Cosmos instead of the effected potence and phenomena.

All phenomena are mechanical in the true sense of this word, as they are always the effect of some change of matter in movement, therefore it is erroneous to admit the abstract conception of mechanism as an independent reality; all phenomena take place within the universal organism, in which any mechanical motion or effect of movement cannot be separately conceived, but can be conceived only as a mental or

verbal abstraction without an existence independent from the bodies, like colour or any other so-called property.

All phenomena, compared according to the standard of discrete quantity, are quantivalent in their mutations, so that all natural changes (molar and physico-chemical) are subordinate to the rational principles of quantity, as the so-called laws of Mechanism are nothing more than corollaries derived from the universal principle of conservation. In any functional transference or propagation of vitality, as in any other physiological change, we must admit the principle of mechanical quantivalence—that is, a proportional interchange in the energy of antecedents and consequents. Therefore in organism, as well as in inorganic machines, there is always a direct relation between the molar work produced and the heat expended; this in turn must be in direct relation with the chemical movements which produce it, and these reactions must be proportional to the progenic currents which change the position of the molecules.

If Mechanics were well known in its most comprehensive or etymological signification, it would be the science which would interpret the genesis of natural phenomena, and would embrace the study and explanation of all material mutations in Cosmos, determining the force of every change, which, in corpuscular matter, is equal to the product of the mass and half the square of the velocity. The physical, chemical and biological theories, now widely disseminated under contradictory principles, must be thus unified.

All material changes, whether manifested or not, though multiple in the sensual appearance, always arise from matter in movement. Hence, we repeat, all mechanical force must always be supposed as a concrete measure comprehending the two factors of all movement, mass and velocity; we must never

suppose the ideal existence of abstract forces without dimensions moving across empty space, neither must we admit them to explain the functions of organism.

Cosmic and biological syntheses, in as far as we can know them, are under the control of Mathematics. A true inquiry into Nature and the proof of physiological truths have for a base the facts of extrinsic experience, from which our reason calculates the relations which must serve us to develop the Physiological Theory. Mechanical theorems are the real guide of physiological science; the principle of conservation is common to physical and chemical changes, to acts of vitality, and to astronomic movements; the calculation of the movements of visible bodies (Molar Mechanics) must be applied to the invisible particles called molecules (Molecular Mechanics) and to progene (Progenic Mechanics).

When we question the material world, whatever its state may be, the determination of quantity by calculation (*i.e.* by the infallible law of number) is a help of undoubted exactitude. But unfortunately we cannot numerically determine phenomena in all cases; science has scarcely passed from the analytic acquisitions of irreflexive experience, qualities for this reason being yet erroneously considered as objective properties. In actuality, much imperfection of true scientific knowledge yet prevails; nevertheless it does not weaken the base on which the principle of conservation rests, because, our intelligence penetrating more deeply than our senses, foresees the true analogy, where sensations show us what falsely appear to be essential differences. Although up to the present time science has not been able to prove numerically all physiological facts, we have arrived at an ultimate principle which comprehends them all, both known and unknown: that is, though much remains to be discovered, we have sufficient knowledge to

declare that all the laws of the science of Nature are comprehended in the principle of proportional interchange (quantivalence), which is synonymous with the principle of persistency or conservation. For this reason, after numerous observations, we have convinced ourselves that all future discoveries will be subordinate to the universal principle of conservation and in accordance with the ultimate postulate of uniformity; hence the true progress of the Physiological Theory consists in explaining the derivation of all empirical laws actually proclaimed in Physics, Chemistry, Cosmology, and Biology, by the conservation of energy in Cosmic Mechanism.

In the Physiological Theory we must not confound the evident principle of conservation of energy with the erroneous supposition of continuity in transformism, as this doctrine employs the word conservation in such an ample sense that it completely lacks a fixed signification. Furthermore, transformists include in "continuity" the reason of its antithesis, "variation," although they pretend to disguise the opposition or contradiction of terms with the adjective "infinitesimal," and then qualify as continuous the variations they call infinitesimal. The Physiological Theory resolves this problem without the intervention of moving forces in Nature, and without appealing to such a fallacy as that of transformism: in fine, it settles that Cosmos does not follow the phases of transformistic evolution, but is in a true involution.

CHAPTER XXIV.

COSMOGENY (*continued*).

(B. Circulation of progene : reparation of living force in Cosmos.)

AMONG the questions which have been the subject of greatest controversy, the most important is how to explain the reparation of the living force which is constantly dissipated in the world.

We have already demonstrated the error of admitting abstract or causing forces in matter, as well as inherent properties like elasticity and movement. The Universe left to the sole action of mechanical energy has the tendency to relative repose, and in this state there could be no manifested change, because progene would soon be reduced to uniform oscillation, which is latent of course ; therefore, from such a condition any other consequent cannot be derived than the perfect stable equilibrium of all bodies. Such loss of actual force, with the tendency to relative repose, is well and clearly seen in all visible or molar movement, and also in the partial movements from which molecular phenomena, as thermo-physic and thermo-chemic changes, arise. We can most palpably appreciate the dissipation of manifested action in the collision of inelastic bodies, and in fire when the combustion is complete ; but all phenomena would cease if the initial impulse, which is the power of redistribution in organism, should not constantly repair the living force, so keeping Cosmos in uniform reaction.

No phenomena can occur in Cosmos without some change of matter in movement; progene is the medium in the organic as well as in the inorganic world by which propagations and transferences of movement at a distance are made, and also for determining the phenomena or manifested operations and the potential or latent changes produced by invisible movements. Let, us then, give a summary idea of progenic circulation, as this is the cosmic medium used by vitality to effect the actual changes in all matter, in the inorganic as well as in the organic world, constantly transferring matter from one to the other, and so producing the incessant whirlpool of cosmic material change.

In order to understand this point thoroughly, we first call attention to the periodicity of cosmic changes, whose proximate cause is vital action and reaction, and whose primordial cause is therefore the Creator. In fact, it comes within the province of Biology to treat of the problem of the periodicity of vital acts, and principally of diurnal and annual alternating differences, because such a periodicity depends on a general condition of organism as a proximate cause, and it is manifested in animal as well as in vegetable life, although it is more noticeable in vegetation. But the results of such periodicity are functions of the total Cosmos, and for this reason it must be treated of here.

Intrinsic and extrinsic interactions of living bodies, although continuous and therefore simultaneous, are variable in quantity, alternating in periodicity in their increase and diminution in such a manner, that when the intrinsic increase the extrinsic decrease, and the reverse, so being always reciprocal. Such variations are recognised in vegetable life by the differences between absorption and elimination of matter during the day and night, and in animal life, especially in the superior scale,

by the difference during their waking and sleeping hours. Here, in spite of their reciprocity, there is a coincidence between them: the greater part of the animal as well as of the vegetable kingdom have their intrinsic activity in molecular changes of oxidation greatly exaggerated during the night, while the extrinsic is more exaggerated during the day; in fact, almost all living bodies absorb more oxygen and eliminate more carbonic acid during the night than during the day.

All changes manifested in Nature proceed from the movement of collocation or redistribution of matter in organism, which constantly produces the transference of latent oscillation of progene into translatory movement in order to produce the chemical metamorphoses necessary for the multiplication and growth of organic structures. This determines in the Universe a constant current of progene, which sets ponderable matter in movement, so as to produce manifested changes in those parts which are in a latent state or in relative repose, the loss of living force in the world being thus compensated. This compensation in phenomenal Cosmos has been explained up to the present date by the myths of a scientific polytheism which admits plurality of abstract or causing forces in Cosmos.*

Sunshine or photothermic irradiation is only the occasional cause acting as a stimulus and means for the growth of green vegetation, which absorbs and appropriates the sun's rays (progene) by the action of the chlorophyll, the progene serving as a means of transporting the molecules into the arrangements required by the organic structures. A biological reaction is the same as any other chemical combination in which the

* We call living force the phenomenal or actual energy, excluding the latent or potential, which is not manifest to the senses.

molecules must be moved by progenic currents, although in organic collocation (vegetable and animal cellules) such currents are necessarily under the direct government of the Almighty, who is the only and true Vital Principle.

Progene is accumulated in all organic corpuscles by a chemical operation called reduction. The more complex living matter becomes, the more progene it contains; and when organic matter is decomposed by the chemical operation called oxidation (which is contrary to reduction), the progene is freed, and produces in this change either progenic propagations (sound and light), or molecular transferences (changes of temperature and of physical state), or else it may produce visible or molar movements, of which further mention will be made. In this manner vitality puts in action the mechanical force which can be determined by the various forms of movement —progenic, molecular, and molar. This point is worthy of further consideration.

Organic phenomena or acts of vitality, which are simply called functions in Physiology, need for their production some previous change in progene, by the increase or decrease of its oscillatory movement and the transference of this into translatory—thus disturbing organism by an unequal distribution of progene, which is condensed at some points and rarefied at others. As a natural consequence of this disturbance in the equilibrium, currents of progene are produced in the moment when there is free contact or possible communication between the condensed and rarefied points. These currents carry the molecules with them, and combine them so as to form the immediate principles, mixing these among themselves in order to construct organic forms. The first result of such a chemical process is a great condensation of progene in the cellules, principally in those which, containing

chlorophyll, are capable of absorbing the progene of the solar rays. The vegetable world above all is engaged in forming the immediate principles—accumulating progene and ponderable matter in highly complex combinations. Owing to its course, progene drives the molecules as well as the masses of ponderable matter to determine their cohesion and translatory movements, when these are the effect of an invisible propulsion. So also a current of progene is produced which flows towards green vegetation; and in this movement the progenic parcels collide, so increasing the energy of their oscillations, which must control the resistance of the molecules and move them in order to determine the thermic and chemic changes of living matter, called altogether trophic or nutritive functions.

Chemical metamorphoses are of two classes—one of combination, the other of decomposition. The decomposition of an organic structure determines the contrary of that which occurs in its formation, freeing the progene before condensed; and so all kinds of transference can take place, of which the following are worthy of mention :—(1) Production of heat (by a mechanism which it is not necessary to repeat here); (2) Production of light, when progene escapes in a diffuse manner and in such a proportion as to impress the retina, and of radiating heat if this change is not manifest to the eye; (3) Production of positive electricity if progene is newly confined in a body and in a latent state, which can occur in two ways: in the form of a current (dynamic electricity), or in repose (static electricity). In addition to this, as progene, in order to accumulate at some points, must leave others rarefied, it produces latent forces, which are principally manifested by the effects called magnetic electricity. But the different classes and forms of movement being transferable, all forms of phenomena afterwards result. Among these the most

striking are molar movements, which in turn are converted into molecular and progenic. Thus, for instance, the molar vibratory movement of bodies is the ordinary manner of producing sound; but the transmission of sound, which is the chief characteristic of this phenomenon, is produced by the transference of such vibrations into oscillatory movements of progene.

In order to understand more clearly the circulation of progene, we may compare it to the circulation of the blood, and in accordance with this parallel divide it into a major and minor circulation; the former is the interstellar and the latter the terrestrial current. The heart is represented by the living bodies or organic world, the great capillary net by the ocean of interstellar progene, and the small or pulmonary net by the earth itself. The greater current of progene flows towards the illuminated hemisphere of the earth, and flows from the shaded hemisphere towards interstellar space; this is the impulsive force of the total movements, orbital and rotary, of our planet. The lesser circulation or smaller current flows within and over the surface of the earth, especially from the equatorial regions towards the poles, where there is a great want of progene on account of the scarcity of vegetable in proportion to animal life. This is the great magnetic current which directs the magnetic needle to the pole.

There are four phenomena in the terrestrial globe which are effected by permanent movements of progene: such are the orbital and rotatory movements of the earth, terrestrial magnetism, and gravity. We must explain more clearly the total movements of the earth by the progenic currents, which are chiefly the effect of contrary reaction in vegetation during the day and the night.

We have already said that the explanation of terrestrial movements by means of planetary forces is null, and yet astronomers admit two planetary forces, one instantaneous and the other continuous; the former they suppose to have existed at the moment when movement was originated in the celestial bodies, and the latter is what they call universal attraction. It is true that the sun and moon have great influence over the movements of the earth; but this is not the result of attractive forces,—it arises from luminous reflexion, better called photo-thermic. Supposing the earth in a determined position in relation with the sun, that half which is illuminated absorbs calories and gives forth oxygen, while that which is shaded absorbs oxygen and emits carbonic acid and calories (progene). Besides, animal life having a greater molecular change while sleeping—that is, emitting more carbonic acid and absorbing more oxygen than in waking hours—contributes to increase the effects of the nocturnal change of vegetation. To this action nocturnal animals do not, of course, contribute. In this manner two progenic impulses are produced on the surface of the earth: one diurnal, in the direction of the sunlight, and the other nocturnal, in a direction contrary to that of the escaping progene in the shaded hemisphere; and according to the principle of Mechanics the resultant of two forces acting in different directions is a parabolic movement. But besides this, as the resultants of such impulses are not in the direction of its orbital movement, they determine at the same time the diurnal rotation of the earth. Of course, the activity of vegetation has no sudden variations; they are gradual in the endothermic as well as in the exothermic process, whose maximum of intensity must be at noontime for the first and after midnight towards dawn for the second. Accordingly the night impulse may be compared to the propulsion of powder

in the combustion of fireworks ; such an impulse acting alone would drive the earth in a closer curve towards the sun, but the force of photothermic irradiation is an obstacle to such approximation, as its direction is entirely contrary to that of the other force.

The result of such a conflict is not alone a planetary revolution ; the progene in such progressive movements collides with the corpuscles of ponderable matter, from this interaction arising the so-called molecular forces of attraction (gravity) and repulsion (thermity), and finally producing the force called affinity when chemical metamorphoses result from the conflict of such motions.

With this we conclude our physiological inquiries, because the direction or government of such progenic currents, which produce the structures of organism, completely escape our sensual observation ; it only remains for us to add, that by means of such organic collocation living matter manifests nearly twice the energy it acquires from the cosmic means, so producing a transference contrary to inorganic machines, as it converts latent energy into phenomenal. This is the true interpretation of the law of conservation in the actual state of the Cosmic System, and the correct explanation of the reparation of living force in Cosmos.

CONCLUSIONS OF THIS PHYSIOLOGICAL THEORY.

SUMMARY:

1st. THE OBJECT OF UNIVERSAL PHYSIOLOGY IS TO MAKE THE ANALYSIS AND SYNTHESIS OF COSMIC MECHANISM, UNIFYING ALL THE THEORIES OF PHYSICS, CHEMISTRY, BIOLOGY, AND COSMOLOGY.

2nd. WE ADMIT THE UNITY OF SUBSTANCE AND ACTIVITY IN MATTER, BUT NOT ATOMIC UNITY.

3rd. THE PROPERTIES AND FORCES OF MATTER, INCLUDING GRAVITATION, ARE SIMPLY THE RESULTANTS OF THE INTERMOTION OF PROGENE WITH ATOMS.

4th. ALL PHYSIOLOGICAL PROPOSITIONS AND LAWS ARE SUBORDINATE TO THE PRINCIPLE OF CONSERVATION—THAT IS, ALL PHYSIOLOGICAL CHANGES ARE PROPAGATIONS OF MOVEMENT WITHOUT ANY NEW CREATION OR ANNIHILATION.

5th. WE PROCLAIM MONOTHEISM IN SCIENCES, ADMITTING THE CAUSAL UNITY OF THE UNIVERSE, AND REJECTING ALL ABSTRACT OR CAUSING FORCES IN NATURE.

CHAPTER XXV.

CONCLUSIONS OF THIS PHYSIOLOGICAL THEORY.

First Conclusion.—Our object has been the analysis and synthesis of Cosmic Mechanism, unifying all the theories of Physics, Chemistry, Biology and Cosmology. We have adopted the title UNIVERSAL PHYSIOLOGY to comprehend the whole abstract knowledge of material Nature or physical Cosmos. This is effectually an organic system, whose special analysis has been divided in this work into three great departments, Molar, Molecular and Progenic Physics; and whose synthesis has been divided into two departments, Biology and Cosmology, according as it is partial, referring to living individuals, or total, referring to Nature as a whole.

All the changes of Nature may be divided into two groups—phenomenal or manifested, and potential or latent. There are two kinds of phenomenal changes, total and partial; in the former we see the movements of bodies, while in the latter the movements are recognised only by the intelligence which refers them either to the two constituents of bodies, molecules and progene, or to progene alone. From this arises our distinction between molecular and progenic phenomena, each comprising two kinds, which with molar movements give us five kinds of natural phenomena. Furthermore, we have already mentioned another kind of change, which we have

denominated potential, and this gives us the sixth material change, as shown in the following correlative order:

1st,	Molar Phenomena	:	Visible movements and equilibrium of bodies.
2nd,	Thermic ,,	:	Changes of temperature and of physical state.
3rd,	Chemical ,,	:	Metamorphosis in the composition of bodies.
4th,	Acoustic ,,	:	Oscillatory movement of progene.
5th,	Optic ,,	:	Photothermic emission of progene.
6th,	Potential Changes	:	Electricity, latent and radiating heat.

In molar phenomena the body changes its place in totality without changing the relative disposition of its corpuscular and progenic constituents; in molecular phenomena there is a change of place in the minute corpuscles of bodies, and therefore a change in the two corporeal constituents, without any total movement; and in progenic phenomena the change is in progene alone apart from molar or molecular movement.

The distinction in physiological changes between propagations and transferences is relative, as in fact all material change consists simply in propagation of movement, and never in a true transference; but the propagation may be either homologous or heterologous—that is, without or with change in the form of movement—and from this arises our relative distinction between simple propagations (homologous changes) and transferences (heterologous propagations). The most remarkable thing in transferences is that the intermediate change is not ordinarily manifested, almost all taking place in the organic and inorganic world by means of potential transmission. Thus the conversion of molar movement into heat, of this into chemical action, of molecular phenomena into progenic changes, and *vice versâ*, need the intermediate action of progene. There can only be a direct conversion when there is a transference of molecular change into molar movement, as occurs in the transference of heat, or of the movements of physical

state or of chemical reaction into useful work or into dangerous explosion.

In a final analysis all the changes of vitality, that is, all functions of organic bodies, are reduced to the different kinds of propagation of movement which have been comprehended in Analytic Physiology. We must not forget that mental activity must be separated from the synthetic concept of vitality, in which there is only that which is properly organic.

Viewed from an etiological standpoint, vitality has a very important natural condition, as it is the first effect or immediate consequence of the True Cause of mechanical order in the Cosmic System—that is to say, it is the first operation of the sole causal law through which the direct purpose or immediate aim of the Creator is effected. But Biology circumscribing itself to the limits of material nature, vitality is the object of our study only in the succession of potential and phenomenal effects—*i.e.*, in the functions of living bodies.

Second Conclusion.—We admit the unity of substance and activity in matter, but not atomic unity. To prove the identity of matter, or substantial equality of all the objects of nature, it is sufficient to know that we cannot perceive in them more than differences in the relations of space and time, as all sensations result from propagation of movement, which can be but of one quality. Qualitative differences are formed in the mind from such quantitative changes; they are not really objective, but subjective; therefore progene (the ether of the physicists) must be considered in its natural quality or essence as a substance identical with ponderable matter, and all bodies, even those considered elemental in Chemistry, must also be considered identical in their essential quality.

We must not confound this idea of material unity with that

asserted by atomists. We cannot admit atomic unity because, among other reasons, the principles of thermo-dynamics are sufficient proofs to convince us of the error of the atomic hypothesis of progene, which must necessarily be distributed into variable parcels. The atomic hypothesis assimilates progene to the gaseous state, but this is completely contradictory to fact, and insufficient to explain imponderable changes. The difference between progene and atoms lies only in the relation of condensation, the atom being an invariable corpuscle of almost twice the condensation of progene, as the calculations of propagated energy lead us to infer by showing us a dissipation of 46% of manifested or living energy, which, as we have seen, is a loss resulting from gravitation, an effect of the action of progene on atoms. The condensation of matter in atoms must be equal in all bodies, as such a ratio is invariable, the differences between atoms then being in volume, and perhaps in shape. Such an idea of substantial unity, though undoubtedly a true one, according to mental analysis has not a practical confirmation, for in the laboratory all bodies cannot be reduced to one alone.

The realistic idea of chemical transformism pretends to be based on the unity of matter; but such a hypothesis, like all those which try to explain the evolution of Cosmos, surpasses the limits of positive knowledge. We must restrict ourselves to the possibility of physiological succession, discovering always and everywhere in nature effects alone; we can never explain the True Cause nor investigate the primordial genesis of Cosmos. Such inquiries belong to Metaphysics. With this restriction of Physiology to calculate effects alone—*i.e.*, to establish the relative laws among the objects of Nature—we will consider progene as the first material element of evolution

in Cosmic Mechanism. The different forms of matter in the constitution of Cosmos are shown in the following table :—

- **Inorganic Matter.**
  - Imponderable and distributed in variable parcels . . . . . Progene.
  - Ponderable and distributed in invariable particles : atoms.
    - Fluids
      - Molecular . Gases.
      - Hydrocular . Liquids.
    - Solids
      - Asymmetrical . Amorphic solids.
      - Symmetrical . Crystals.
- **Organic Matter.**
  - Total or complete : Primordial form or germ . Ovules.
  - Partial or incomplete : Derived forms . .
    - Blastema.
    - Protoplasm.
    - Cellules.
    - Fibres.
    - Tubes.
    - Membranes.

The progressive scale of evolution in matter is as follows :—

- **Simple bodies practically irreducible.**
  1. Progene = Imponderable matter (ether of the physicists).
  2. Protilo (helium ?) = Primary condensation (perfect gas ?).
  3. Most permanent gases = Secondary condensation.
  4. Simple bodies that can take a liquid form (many elements).
  5. Simple permanent solids = carbon.
- **Compound bodies reducible to simple bodies.**
  6. Compounds without carbon.
  7. Ternary compounds of carbon = Hydrocarbonates.
  8. Quaternary compounds of carbon = Albuminoids.
  9. Protoplasm = Organic granular matter.
  10. Ovules = Unicellular organisms and germs of all living bodies.

We cannot interpret this scale by the doctrine of infinitesimal continuity—the fundamental principle of transformism ; we must not suppose that because matter leaps infinitesimally, or changes gradually from one form to another, such a change can be made by matter alone without the intervention of a Motor.

Third Conclusion.—The so-called properties and forces of matter, including gravitation, are simply the resultants of the intermotion of progene with atoms. The ideas of the authors about the mechanism of gravitation, chemical combination, magnetism, and the other phenomena which they erroneously

suppose as effects of enigmatic attractions and repulsions, are a contradiction to the true facts of inertia, and therefore to the principle of conservation. Attraction and repulsion denote constant creation of mechanical power, so as to produce a continuous source of movement; but if such a power truly existed, the cosmic principle should be one of generation instead of conservation, and then matter would not be inert.

Material nature is inert in living as well as in inorganic bodies, it being demonstrated by the facts of inertia of matter that all objective activity is primarily or genesically produced by an agent which must exist apart from matter itself. Hence, the hypothesis of universal attraction is an irreflexive idea of imagination—it is a fallacy of language; and as it represents an impossible force, it is still better to say it is the name of nothing, and it is as absurd to apply it in Chemistry to invisible particles as in Astronomy to great masses. It is furthermore unnecessary for Science to admit abstract or causing forces in matter, because we can explain all natural phenomena without admitting attraction among the planets, without the molecular forces of cohesion, adhesion, etc., without chemical affinity, and finally, without any vital force outside the Generator. Neither must we admit any property considered as inherent to the material element, as elasticity, extension and impenetrability, which are relative conditions resulting from the intermotion of progene and ponderable matter according to the mode of molecular aggregation of bodies. It is therefore erroneous to pretend that elasticity repairs the dissipation of living force in Cosmos.

The hypothesis of attraction must be substituted by the rational theory of continuous impulsive movement which is propagated by means of progene from molecule to molecule as well as from star to star. Thus, in acts that at first sight or to irreflexive observation appear to be far removed from a

possible interpretation, our reason discovers analogies with the works seen in the most simple machine.

We have admitted throughout Cosmos the existence of a meta-fluid substance which serves as a universal means, and which must be recognised as a real object although it is neither tangible nor ponderable. The existence of such an imponderable meta-fluid cannot be denied, because the interstellar changes suppose transmissions of movement, and empty space cannot move. Again, when the minute particles of a body move in a change of temperature or of physical state, or in a chemical metamorphosis, something must impel the particles, as they cannot move of themselves alone; this something must be the substance we call progene, which is necessary in the world to explain sonorous, luminous, thermic and electric transmissions, and so directly impresses the eye and ear.

Accordingly, the reparation of living force in the world is produced by organic generation, being directly subordinate to the Primordial Cause or Creator. All manifested changes are proximate or remote effects of the generating power of vitality; the First Principle directly gives organic bodies their power of collocation or redistribution of matter in the Universe.

Fourth Conclusion.—All physiological propositions and laws are subordinate to the principle of conservation—that is, all physiological changes are propagations of movement without any new creation or annihilation.

Molar Mechanics, Physics, Chemistry, Biology, and Cosmology, which altogether compose physiological knowledge, contain only relative propositions and laws whose predicates are quantitative. The attributive propositions which express predicates of quality only give us a knowledge of the mental states, and not of the material—being therefore metaphysical, not physiological.

All Cosmos is in movement, and the degree of movement is distributed among all parts by propagation, changing either instantaneously or continuously, so producing the different energies of nature, which are classified in the following table :—

1. *Energies primordially derived, or functions of organism : Vital Synthesis.*

Invisible movements	Progenic change :	potential transmissions (like electricity)	Innervation.
	Molecular change :	thermo-chemical phenomena	Nutrition.
Visible movements	Complete division :	cellular excision . .	Reproduction.
	Return movement in	cellular elements . .	Contraction.

2. *Energies secondarily derived, or changes of the inorganic world.*

Progenic or imponderable energies	Potential changes	Quantitative change of progene	Electricity (static and dynamic).
		Change of progenic oscillations	Potential heat (latent and radiant).
	Manifested changes	Translatory movement of progene	Light.
		Oscillatory movement of progene	Sound.
Ponderable energies	Molecular changes	Change of intermolecular distances	Heat (temperature and state).
		Change of molecular extension	Affinity (chemical change).
Molar changes : Visible or ordinary movements.			

The interstitial parcels of progene are constantly in oscillatory revolution, which may produce in molecules repulsive or expansive effects (heat); at the same time such parcels are under the pressure of ultra-atmospheric progene, which produces a force, centripetally propagated, in proportion to the mass and the square root of the distance, so producing in corpuscles and bodies an apparent effect of attraction (gravity). From two such antagonistic movements the different forces

called attraction and repulsion result; all authors, for instance, saying "force of cohesion" when they refer to the union of homogeneous corpuscles, and "force of affinity" when they refer to the combination in definite proportions of those which are heterogeneous.

Chemical changes are primarily effected in the acts of organic collocation, currents of progene being simultaneously produced with them. From this perturbation all natural phenomena, and the potential changes of living as well as of inorganic bodies, are derived. Thus, for instance, the propagation of oscillatory movement to the interstitial progene of a body increases the force whose effects appear to be the result of molecular repulsion, and then we may have either increase of temperature or change of state, and even chemical decomposition may take place. But for this a potential change, consisting in progenic currents, must necessarily co-exist; and these may become phenomenal either by transference into very minute and accelerated emissions of progene, which, irradiating to the retina, may produce the sensation of light, or by transference into less minute and less accelerated *oscillations* of progene, which, propagated to the ear, may produce the sensation of sound. Again, all forms of invisible movement, but especially heat, are transferred into molecular work, either in animal economy or in machinery; and finally, if we suppose a change in gravitating pressure, it will produce phenomena having the appearance of attraction contrary to those before mentioned. Among these the principal are chemical combinations, terrestrial movements, terrestrial magnetism, and gravity. In the last the periodical increase and diminution (alternating every six hours) is very remarkable; and this, like the other planetary phenomena, depends on the diurnal and nocturnal changes of organisms.

Fifth Conclusion.—We proclaim Monotheism in science, admitting the causal unity of the Universe and rejecting all abstract or causing forces in Nature.

Mechanism is nothing really independent; it is the concept of an abstraction from objective or material nature, making the elision of the Primordial Cause. We cannot explain the creation of matter, nor the primordial determination or generation of manifested or living change in organism; but we may refer to the subject of vitality, and say that it is a supreme power, and not a transference from mechanical energy, because this does not suppose anything more than matter in movement under the different forms of secondary activity. The proofs of this assertion are the impossibility of affirming the contrary, and the principle of conservation.

The uniformity in the order of the Universe compels us to admit that it is an organised system, for which we must recognise an Organiser whose power is not directly manifested in any form of matter but organisms. Hence, God as Organiser is the principle of vitality—that is to say, vitality must be considered as the only activity really originated, and such primordially derived unity is the proximate cause of phenomenal motion in Cosmos. This idea must substitute that host of abstract forces admitted by authors as exciting the world to action.

Physico-chemical forces are only the result of movements; they are not causes, and still less can they have the conditions of intelligence necessary to accomplish the determined principle and final aim of the System.

The prime influence which governs living bodies is a perpetual miracle, which we can only know by the continuous effects it originates in organism—first in imponderable material or progene, and secondly in the continued transference of

ponderable matter in and among different bodies. In Nature there will always remain an eternal mystery to us: this is the continual creation of phenomenal activity in organism, which is revealed to us under two forms—generation of new beings or multiplication, and growth or development of living beings. The other changes of Nature exist in a continuous succession, keeping reciprocal equivalence among themselves.

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What has been said is sufficient to make known to us the solution here given to the knowledge of Nature; and in *recapitulation* we will say that the perfection of physiological acquisitions is the result of calculation, and scientific progress will advance with the mathematical exactness of the relations formed among phenomena, experience being the means of gathering the irreflexive ideas of particular facts; and true knowledge is acquired when reason can apply to every single case the principle of conservation, in which we find the mechanical unity of Cosmos, which is supernatural or immaterial.

Our reason has conducted us at the close to three ultimate terms: one material, unconscious, which is only perceived extrinsically by propagations to the senses, differing according to the relations of space and time; another mental, conscious, which is only perceived intrinsically, and without any other relation in its acts than that of time; and still another containing the capacity of both (material and mental), but not being subject or object of perception for human intelligence. The inevitable desire of thoughtful minds has been to make the synthesis of these three terms in order to determine the absolute unity of the System. Such a synthesis cannot be made by Physiology in general, still less by any of its departments. The divine must not be confounded with the human,

nor the spiritual with the material; the unity of the Universe can only be found in the plan and final aim of the Creator, therefore it is a theological problem.

The circuit in the changes of the Cosmic System, then, is closed not by mechanical propagation, but by the engendering activity of the Creator, who immediately produces the change of latent energy into living force; this is first manifested by the functions of living matter, which afterwards propagates the action to the inorganic world where the manifested energy is dissipated, until it is newly manifested by the Supernatural Potence in *Vitality*.

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